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RADIO & TELEVISION NEWS

JUNE
1955

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World's Leading Electronics Magazine

IN THIS ISSUE

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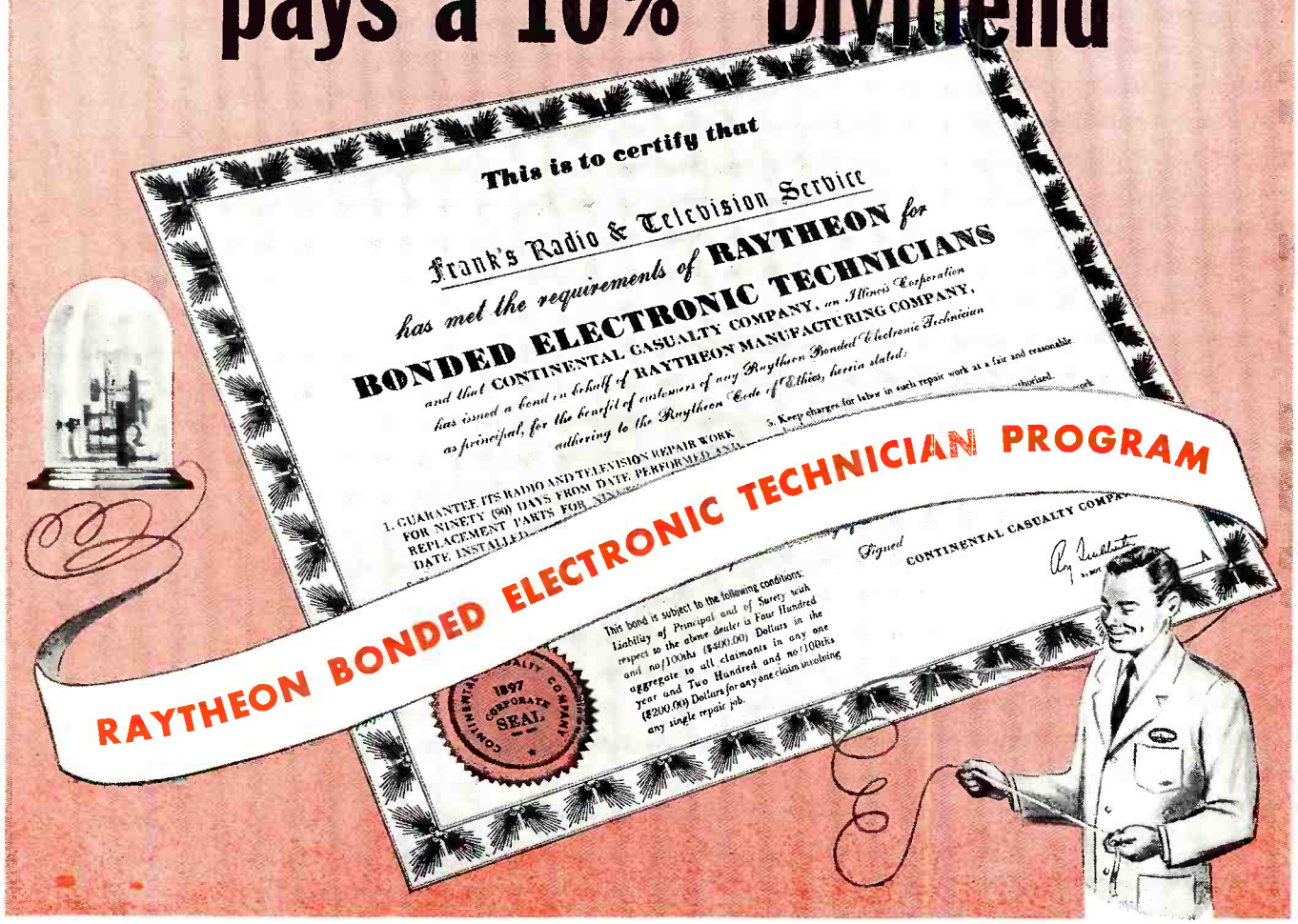

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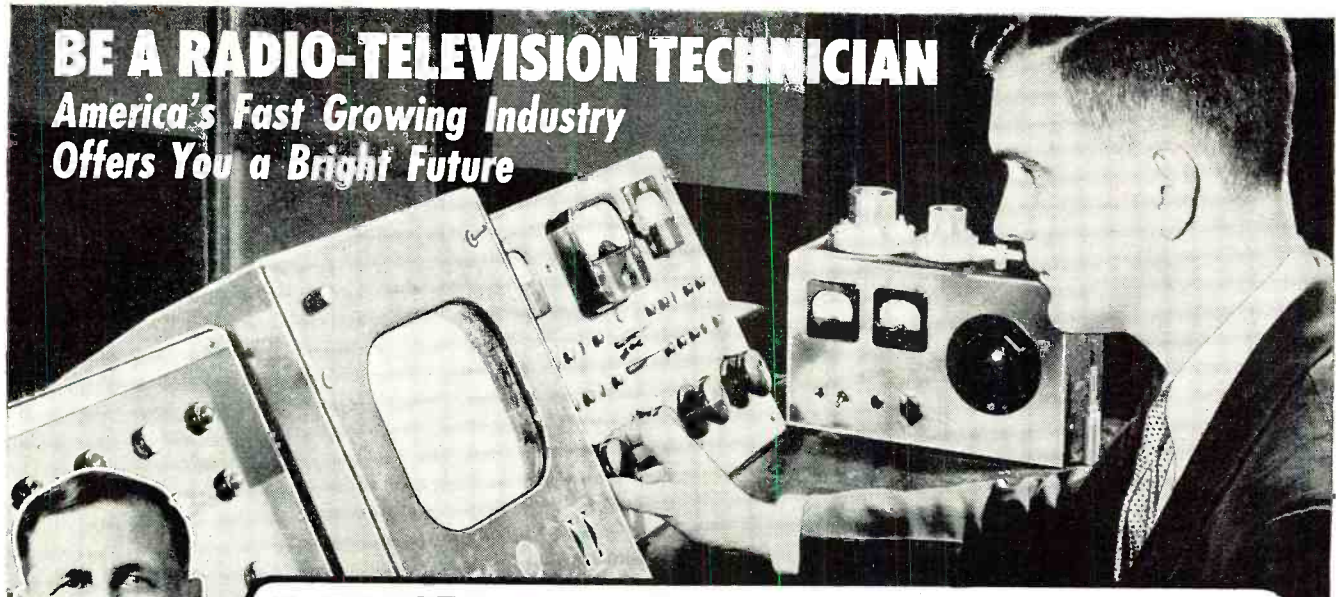

J. E. SMITH, President, National Radio Institute, has trained more men for Radio-Television than any other man. Our 40th Year.

I Will Train You at Home in Spare Time for Good Paying Jobs in RADIO-TELEVISION

I Trained These Men

Extra Money in Spare Time

"Four months after enrolling . . . averaged $10 to $15 a week servicing sets in spare time. Now have full-time business."—William Weyde, Brooklyn, New York.

Chief Technician with Large Shop

"In a year I opened my full-time radio shop. NRI training qualified me as Instructor during war. Now Chief Radio and TV Serviceman." —P. G. Brogan, Louisville, Ky.

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"I decided to quit my job and do television work full time. I love my work and am doing all right. I'm not just punching a time clock." —Wm F. Kline, Cincinnati, Ohio

Video Control Engineer

"My position with WNBT is video control engineer on the RCA color project. I owe a lot of my success to your textbooks." Warren Deem, Malverne, N. Y.

TELEVISION is Making Good Jobs, Prosperity

Radio, even without Television is bigger than ever. 115 million home and auto radios and 3000 Radio Broadcasting Stations give interesting jobs to service technicians, operators, engineers. NOW ADD TELEVISION. 25 million TV homes and the total growing rapidly. 200 Television stations on the air, hundreds more under construction. Color Television soon to be a reality. All this adds up to good pay now, a bright future for men who qualify.

America's Fast Growing Industry Offers You GOOD PAY - BRIGHT FUTURE - SECURITY

Training PLUS opportunity is the PERFECT COMBINATION for job security, advancement. When times are good, the trained man makes the BETTER PAY, gets PROMOTED. When jobs are scarce, the trained man enjoys GREATER SECURITY. NRI training can help assure you and your family more of the better things of life.

Start Soon to Make $10, $15 a Week Extra Fixing Sets

An important benefit of my Radio-Television training is that you can start to cash in fast. I start sending you special booklets that show you how to fix sets the day you enroll. Multitester you build with parts I send helps you discover and correct troubles, helps you make money fixing neighbors' sets in spare time while training. Many NRI students make $10, $15 a week extra this way. My training is practical, complete. You benefit by my 40 years' experience training men at home. My well-illustrated lessons give you basic principles you need, and my skillfully developed kits of parts "bring to life" things you learn from the lessons.

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Without obligating you in any way, I'll send an Actual Lesson to prove that my training is practical, thorough. My 64-page book, "How to be a Success in Radio-Television", shows what my graduates are doing, earning. It gives important facts about your opportunities in Radio-Television, tells about kits I furnish for practical experience. You don't have to leave home or give up your job to take NRI course. You learn at home in your spare time on terms as low as $5 a month. Many of my graduates make more than the total cost of my training in just two weeks. Mail coupon below now to J. E. SMITH, President, National Radio Institute, Dept. 5FE Washington 9, D. C. Our 40th Year.

You Practice Broadcasting-Servicing with Kits of Parts I Send

Nothing takes the place of practical experience. That's why NRI training is based on learning by DOING. My training includes specially developed kits of parts you use to build equipment and get practical experience on circuits common to both Radio and Television. Shown at left is the low power Broadcasting Transmitter you build as part of my Communications Course. Also shown is modern Radio you build as part of my Servicing Course. My free book tells about other equipment you build. Mail coupon. All equipment is yours to keep.

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COVER PHOTO: Los Angeles Airways, a helicopter feeder line, coordinates its many operations with split-second timing by using two-way radio in its heliports and helicopters. (Ektachrome by Peter J. Samerjan)

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DEPARTMENTS

VOLUME 53 • NUMBER 6

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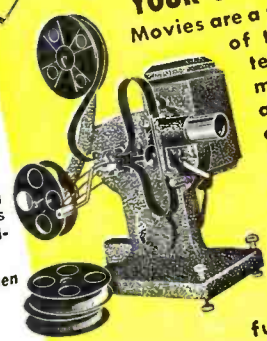

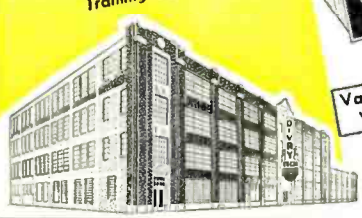

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IF YOU HAVE some Radio or Television experience, or if you know basic Radio-Television principles but lack experience—NRI's new Professional Television Servicing course can train you to *go places* in TV servicing. This advertisement is your personal invitation to get a free copy of our booklet which describes this training in detail.

LEARN-BY-DOING "ALL THE WAY"

This is 100% learn-by-doing, practical training. We supply *all* the components, *all* tubes, *including* a 17-inch picture tube, and comprehensive manuals covering a thoroughly planned program of practice. You learn how experts diagnose TV receiver defects quickly. You see how various defects affect the performance of a TV receiver—picture and sound; learn to know the causes of defects, accurately, easily, and how to fix them. You do more than just build circuits. You get practice recognizing, isolating, and fixing innumerable TV receiver troubles.

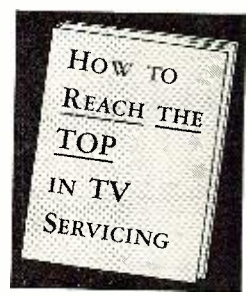
You get actual experience aligning TV receivers, diagnosing the causes of complaints from scope patterns, eliminating interference, using germanium crystals to rectify the TV picture signal, obtaining maximum brightness and definition by properly adjusting the ion trap and centering magnets, etc. There isn't room on this or even several pages of this magazine to list all the servicing experience you get.

UHF AND COLOR TV MAKING NEW BOOM

Installing front-end channel selector strips in modern UHF-VHF Television receivers and learning UHF servicing problems and their solution is part of the practice you get if you live in a UHF area. To cash in on the coming color TV boom you'll need the kind of knowledge and experience which this training gives.

GET DETAILS OF NEW COURSE FREE

Once again—if you want to go places in TV servicing, we invite you to find out what you get, what you practice, what you learn from NRI's new course in Professional Television Servicing. See pictures of equipment supplied, read what you practice. Judge for yourself whether this training will further your ambition to reach the top in TV servicing. We believe it will. We believe many of tomorrow's top TV servicemen will be graduates of this training. Mailing the coupon involves no obligation.



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Please send my FREE copy of "How to Reach the Top in TV Servicing." I understand no salesman will call.

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For the RECORD

BY THE EDITOR

RADAR AND NAVIGATIONAL AIDS

NEW, and many times startling, applications for electronics are becoming daily headlines as this industry continues its more-than-rapid development of color television, communications, industrial electronics, and improved navigational aids.

Radar devices of all shapes and sizes are finding new applications almost every week. Mobile radar is a fast-growing nemesis to the speedster on the highways, and many small communities as well as the large cities are installing these compact equipments in great quantity. The familiar road-signs, "Policed By Radar," are now fact—not an oft-tried fake warning as many were in the past.

A month never passes without an opportunity to witness or to otherwise learn of some development in each of these specific fields. But it is unusual to find several major developments in one particular facet of electronics—announced simultaneously.

Just a few weeks ago, and within a period of a few hours, came the news of three new electronic devices designed to aid aircraft pilots, to eliminate and sharply reduce traffic delays, and to provide greater safety to passengers flying the airways.

A new and compact navigational aid called "Tacan," announced by *I. T. & T.*, provides an accurate and continuous bearing of the pilot's position to within one degree. Distance, as well as direction of flight relative to a fixed ground station, is provided automatically and with extreme accuracy. The unit occupies approximately 1000 cubic inches which is several times smaller than that required to mount previous units. The range of the new system is classified and, as a result, the unit is identified as a short-range navigational aid. "Tacan" is said to provide a distance accuracy of one-fifth mile and an azimuth bearing accuracy to within one degree.

This new equipment was designed at the *Federal Telecommunications Laboratories* in Nutley, New Jersey, and, according to the announcement, accepted by the U. S. Air Force as well as the Naval Air Corps. The system meets the requirements for interservice standardization, it is said.

One of the most common flight hazards of aircraft has been overcome to a great extent as the result of a new airborne radar device which is quite similar to ones used by the military. This perfected instrument shows, on its screen, a picture that reveals "fronts" and thunder storms many miles ahead. Dangerous turbulence, present in those areas, is bypassed by the pilot. The device supplies information on the distance and the location of the "weather" as well as the severity or intensity of a storm center.

Another application for this compact device is its ability to scan an area below and ahead of an aircraft to reveal mountain peaks, lakes, ships at sea, and cities. This performance is selected by the pilot by simply flicking a switch.

One of the major traffic problems of our ever-expanding commercial airlines has, or will soon be licked, by a new long-range radar device designed to reduce or to end traffic delays by cramming more airplanes into a limited area without danger to life, limb, or property. This new powerful radar, borrowed from the Air Force, is being tested in the busy New York area. It will provide data that can offset delays in landings and take-offs.

An airplane cruising at 300 mph (under present regulations) must have 30 clear miles in front and 30 clear miles to the rear at its altitude for safety. The new radar equipment (of much greater range) is able to show, on its screen, all airplanes in a large area. The flight controllers are now able to narrow the safe separation to from 3 to 5 miles at any given altitude. Heretofore, planes were picked up *via* short-range radar when they reached a point about 30 miles from the airport and received their landing instructions. The long-range radar screen now shows these aircraft clearly at a distance up to 100 miles.

This development is sure to be widely heralded by passengers of some 533,000 flights (1954) made by the airlines—many of them "stacked up" waiting to land, or others sitting in a parked plane on the ramp cursing heat in the aircraft as it sits under a broiling sun.

Our own experiences of delays last year would be estimated at a total of approximately 5 per-cent of total flight time. This figures about 5 hours of delays in 1954 alone. And our experience, shared by millions, totals to a lot of wasted time that can be saved by the new long-range radar.

These developments, we think, typify the ever-increasing value of electronics to our way of life in these United States. . . . . O. R.

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Super-Value Knight Push-Button Tape Recorder

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A best buy in recorders! Five push-buttons select all operating functions: fast forward, play-back, stop, record and fast reverse. Takes up to 7" reels. Two-speed dual-track for wide range of recording times. At 3.75" per second, 7" reel records for 1 hour—and additional hour on second half of tape; at 7.5" per second, records ½ hour continuously, 1 hour overall. 7" reel rewinds in 3 minutes. Response: ± 3 db from 75-8500 cps at 7.5" speed; 80-6000 cps at 3.75" speed. Efficient erase system; "lock" prevents accidental erase. Features: two neon recording level indicators, 2-watt built-in amplifier; 5 x 7" oval speaker. Records from mike, radio, tuner or phono. Handsome 2-tone portable case, 14 x 12 x 9". Complete with mike, take-up reel and 600-ft. roll of tape. For 110-120 v., 60 cycles AC. U.L. Approved. Shpg. wt., 29 lbs. **96 RX 675.** *Only* **$89.95**

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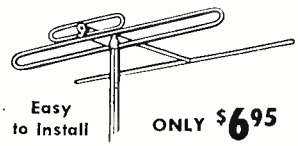

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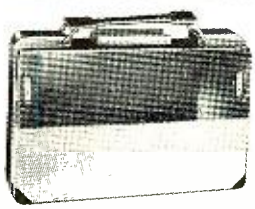

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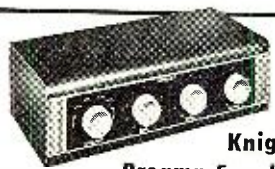

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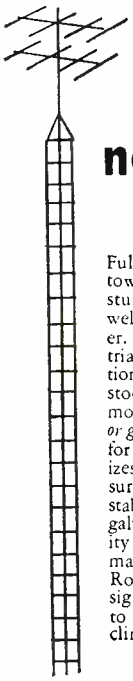

no. 6 tower

"All-Purpose" tower.

Fulfills 75% of your general tower needs—is structurally as sturdy—yet *costs less* than the well-known Rohn No. 10 Tower. Ideal for home and industrial installations, communication requirements . . . eliminates stocking many different tower models. *Self-supporting to 50 ft. or guyed to 120 ft.!* Easy to climb for fast, efficient servicing. Utilizes *"Magic Triangle"* which insures *far* greater strength and stability. Permanent hot-dipped galvanized coating. Dependability — a feature customers demand — is assured with the Rohn No. 6 Tower . . . designed to "stand up" for years to the rigors of weather and climatic conditions.

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Both Towers Feature

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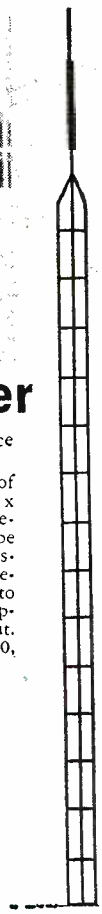
Famous First for Rohn Towers

. . . to add more profits in your cash register.

Yes, you can have these two famous towers in hot-dipped galvanized finish—the most durable and permanent coating of all! What a sales feature for you!



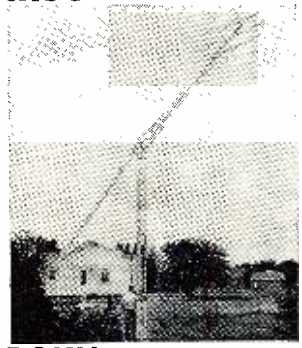
no. 30 tower

Heights up to 200' or more when guyed

Self-supporting up to 60'

Sturdy communication or TV tower that "stands up" to *all* the stresses of weather and climatic conditions . . . will withstand heavy wind and ice loading. Heavy gauge tubular steel, electrically welded throughout. Weather resistant, non-corrosive *double* coating provides durable finish. All sections in 10' lengths. Only 2-4 manhours required for installing 50' tower!

also



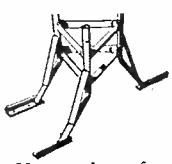
ROHN Fold-over tower

For experimenters, TV service departments and retailers. Use this kit with regular Rohn tower sections. Simple and easy to use.

ROHN Telescoping Masts

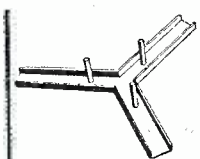
Heavy-duty hot-dipped galvanized steel tubing and rigid joints give extraordinary strength. *Quick installation* . . . mast attached to base—antenna fixed, then mast hoisted quickly to desired height. Utilizes special clamp and guy ring arrangement. Flanged interior section; crimped exterior section gives mast stability that can't be beat. Complete with guy rings and necessary erection parts. In 20, 30, 40 and 50 ft. sizes. Bases and ground mounts available.

and a complete line of ROHN accessories —*all galvanized*



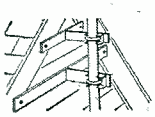
PEAK ROOF MOUNT

Heavy duty for quick, secure mounting of tower to top of peak roof. Flanges hinged, fastened to roof with 2 lag screws in each flange.



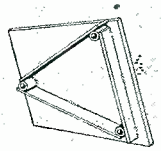
FLAT ROOF MOUNT

For all types flat surfaces. 3–1" solid steel projections permit first section of tower to be mounted directly on roof mount by inserting usual ⅜" bolts.



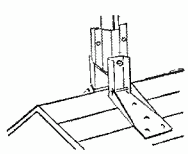
PEAK and WALL MOUNTS

For mounting of mast or pole to roof or wall. Heavy-duty steel. Variable sizes. Models for most every need.



DRIVE-IN BASE

Set on top of ground . . . 3–4' drive rods driven through base into ground. First tower section secured to rods with single bolt in each leg. Instant erection.

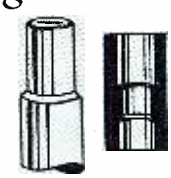


MAST BASES

Complete line of telescoping mast bases for every requirement, accommodating masts from 1"–2¼" diameter. Also available—drive-in mast bases.

SERVICE TABLE

Perfect answer for television servicing, display and storage. Truly one of the finest of its kind in economy price range.



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Heavy-duty, hot-dipped galvanized steel tubing. Machined to perfection. Extra sturdy joints slotted for full, perfect coupling.

ALSO AVAILABLE

Rotator posts for mounting rotator to tower; House Brackets; Guying Brackets; UHF Side Arm Mounts; Mounts for Additional Antennae on a Tower; Erection Fixtures; Guy Rings; Installation Accessories; and dozens of other items!

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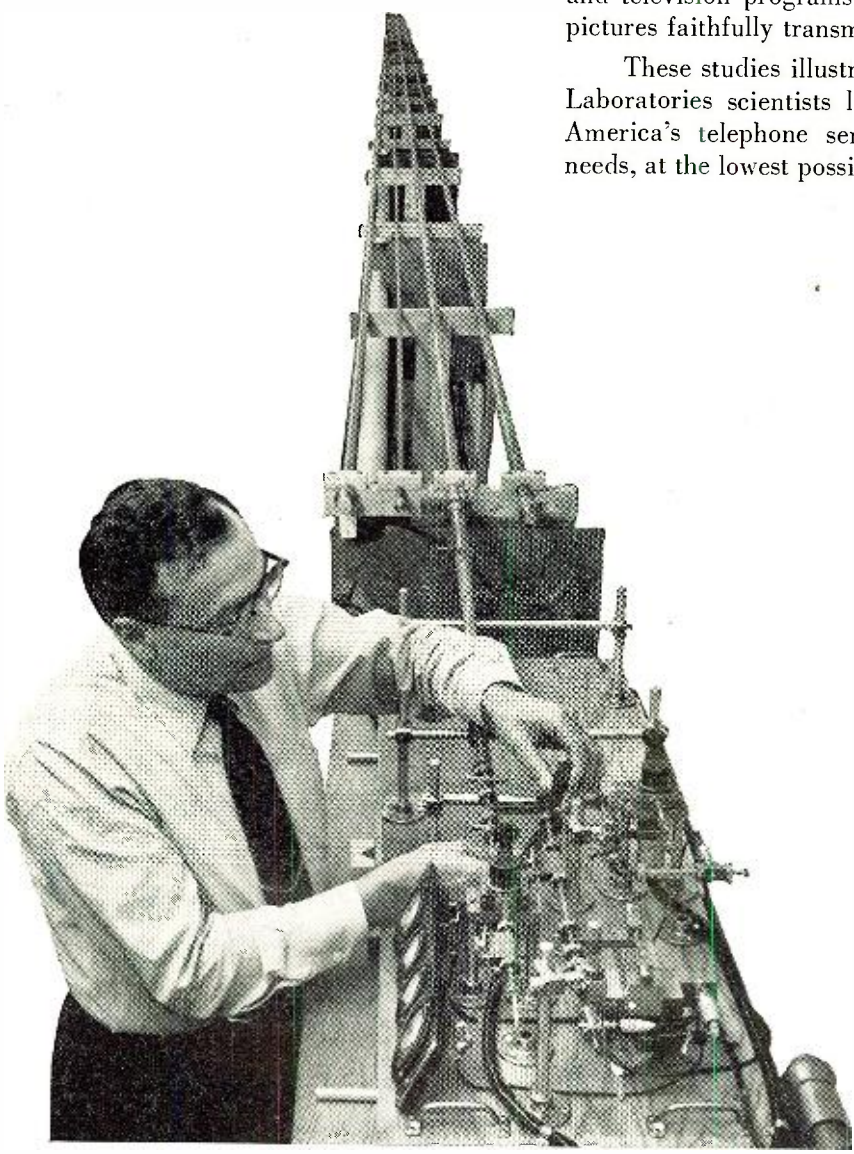
Pipes of Progress

Hundreds of thousands of telephone conversations or hundreds of television programs may one day travel together from city to city through round waveguides—hollow pipes—pioneered at Bell Telephone Laboratories.

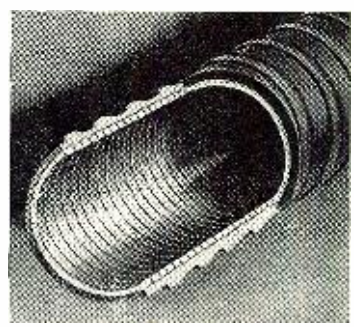
Round waveguides offer tremendous possibilities in the endless search for new ways to send many voices great distances, simultaneously, and at low cost. Today, Bell Laboratories developments such as radio relay, coaxial cable and multivoice wire circuits are ample for America's needs. But tomorrow's demands may well call for the even greater capacity of round waveguides.

Unlike wires or coaxial, these pipes have the unique property of *diminishing* power losses as frequencies rise. This means that higher frequencies can be used. As the frequency band widens, it makes room for many more voices and television programs. And the voices will be true, the pictures faithfully transmitted.

These studies illustrate once more how Bell Telephone Laboratories scientists look ahead. They make sure that America's telephone service will *always* meet America's needs, at the lowest possible cost.



Testing round waveguides at Bell Telephone Laboratories, Holmdel, New Jersey. Unlike coaxial cable, waveguides have no central conductor. Theoretically, voice-capacity is much greater than in coaxial cable.

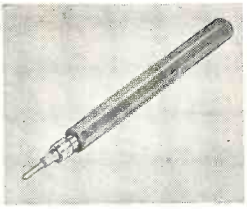


New type of waveguide pipe formed of tightly wound insulated wire transmits better around corners than solid-wall pipes.

New type waveguide is bent on wooden forms for study of effect of curvature on transmission. The waveguide itself is here covered with a protective coating.

G-C VINYLITE CEMENT
Great adhesion; many uses.
No. 58-2 NET $0.39

G-C LACQUER THINNER
Thins all types.
No. 29-2 NET $0.33



G-C LOW-LOSS TEST PRODS
Excellent for high voltage.
No. 5045 NET $0.30

G-C PLI-O-BOND CEMENT
Sticks "anything to anything".
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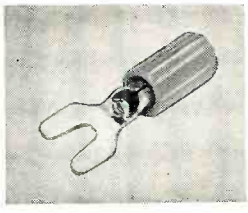

G-C INSULATED SPADE LUG
Red; fits all banana plugs.
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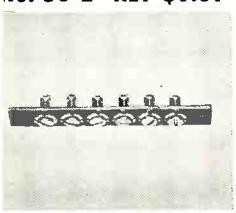
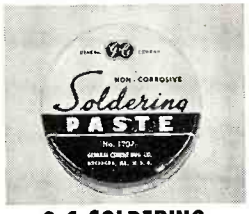
G-C INSULATED BANANA PLUG
Spring type, solderless.
No. 8994 NET $0.21



G-C SCREW TYPE TERMINAL STRIPS
Has 6 contacts; others with 2-10.
No. 1776 NET $0.21

G-C GRAFOLINE
Lubricant for metallic contacts.
No. 120-2 NET $0.39



G-C SOLDERING PASTE
High-quality, non-corrosive.
No. 1207 NET $0.27

G-C SPEAKER CONE RECONDITIONER
Rejuvenates dried-out cones.
No. 25-8 NET $0.60

G-C KRYSTAL KOAT LACQUER
Dries in beautiful patterns.
No. 63-2 NET $0.39

G-C RADIO FRICTION TAPE
Narrow 3/8" Tape, 60-ft. roll.
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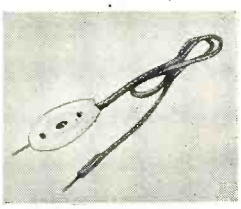

G-C DANDY LITE TESTER
Heavy duty; 60 V AC, 90-550 V AC-DC.
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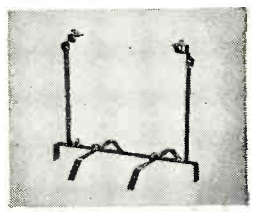
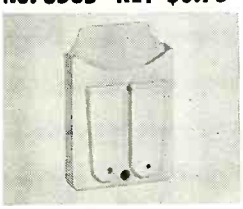
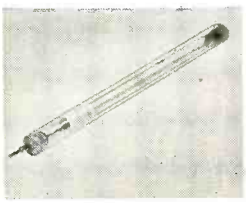


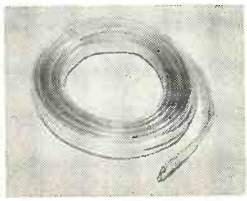
G-C PHONO TURNTABLE STAND
Ideal for all turntable repairs.
No. 5205 NET $4.95



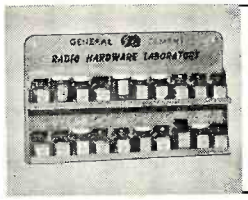
G-C "TUX" TOOL KIT
Carry all needed tools.
No. 8943 NET $2.37



G-C "HI-VOLT" SAFETY PROBE
Neon glow for all high volt tests.
No. 8836 NET $1.65



G-C 300-OHM LINE TUBING
Protects, waterproofs lead-in line.
No. 625 NET $0.66



Contains complete assortment of knob set, cabinet, wood and sheet metal screws; nuts; lock washers; lugs; clamps; cotters; etc.

G-C RADIO-TV HARDWARE LAB
Contains 20 assorted jars.
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G-C UTILITY BOX
Spacious, handy, all-steel box.
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G-C SPEEDEX FUSE PULLERS
Handy, safe for 1/4"-1/2" dia. fuses.
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Famed high grade adhesive.
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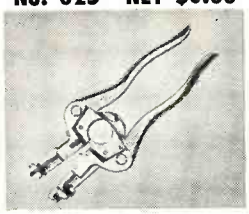

G-C SPEEDEX WIRE STRIPPER
Automatic, delayed action return.
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Power spray contact cleaner.
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Protects, insulates, prevents rust.
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TELCO 10-PACK ANTENNA KLIPS
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Bag of 10
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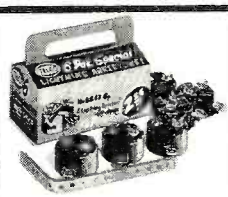

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Pack of 6
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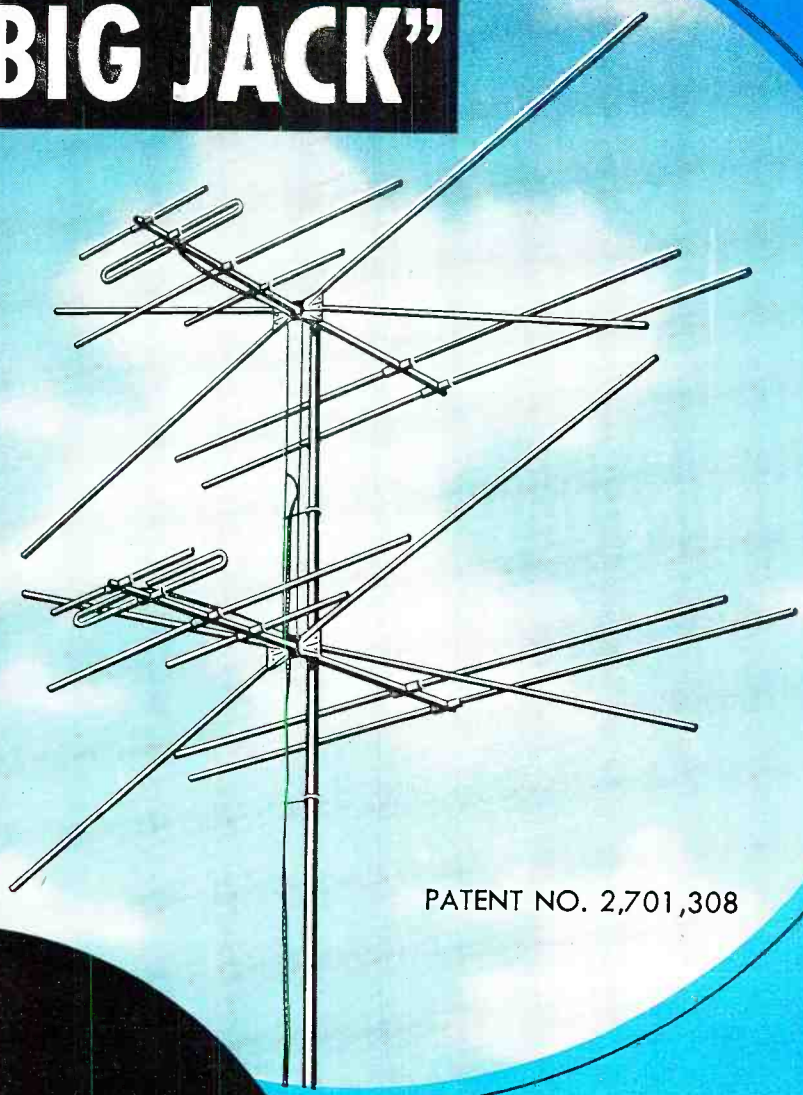

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KAY-TOWNES Announces
THE GOLDEN HARVEST CAMPAIGN
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Complete LINE OF ALL CHANNEL
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Spot Radio News

*** Presenting latest information on the Radio Industry.**

By RADIO & TELEVISION NEWS' WASHINGTON EDITOR

THAT AWESOME TERM 'FREEZE' flashed across the Washington scene a few weeks ago when the Commission's top trio, Broadcast Bureau Chief Curtis B. Plummer; Chief Engineer Edward W. Allen, Jr.; and Chief Accountant William J. Norfleet, issued an interoffice memo calling for a *chill* period, until the Commission could make up its mind as to what to do about the ultra-highs.

Technically, the interim cooling-off period was described as applying only to those very-high applications in cities within 50 miles of an ultra-high community.

The memo noted that the Commission has viewed ". . . with some concern the status of the u.h.f. television service." The problems, they felt, stemmed from the ". . . inability of u.h.f. to meet v.h.f. competition primarily because of lesser coverage, lack of u.h.f. sets, and insufficient or inadequate programming."

Pointing out that the Commission is now concerned with the varied difficulties facing the higher-band stations, insofar as these problems obstruct official action to provide a nationwide service, the broadcast experts said that a study should now be undertaken to determine whether the current rules and policies are serving to promote the broad objectives of the FCC. Accordingly, while such a study is underway, it was explained, any ". . . additional v.h.f. authorizations in u.h.f. areas would only serve to aggravate the situation and would make more difficult any subsequent revision in rules and policies that might be necessary."

Therefore, continued the government spokesmen, the ". . . Commission has concluded that until further notice, requests for TV authorizations on channels 2 to 13 will be considered in accordance with . . . the following procedure . . . :

"Applications pending . . . and filed for permits to construct new television stations . . . will not be acted on . . . where the v.h.f. transmitter or the principal community to be served is located within 50 miles of another community in which a u.h.f. station has been authorized. . . ."

In addition, it was also said, no action would be taken where the problems of increased radiated power, increased antenna height, or antenna movement in the direction of the u.h.f. community were involved.

The temporary shutdown edict was followed by a formal report to the Senate Interstate and Foreign Commerce Committee, in which the Commission bluntly told the Senators that the ". . . failure of u.h.f. to become integrated with the v.h.f. band is manifested by the fact that of the 318 u.h.f. stations authorized . . . only one-third are presently in operation. Many authorized were never actually constructed. . . . And the financial outlook for a number of the operating u.h.f. stations is by no means bright."

Agreeing with the conclusions reached in both the Plotkin and Jones reports that the ". . . only practicable course . . . of action lies in doing what is possible to promote the present allocation plan utilizing both v.h.f. and u.h.f. channels," the Commission said that the ". . . addition of substantial new v.h.f. space or the movement of all television stations to u.h.f. would involve such tremendous dislocation of existing operations and have such a severe impact on millions of viewers, that such action should be considered as a possible alternative only if Congress itself were to determine that the long-run benefits to the public required adoption of such drastic remedies."

Reporting on the possibilities of selective de-intermixture, which might provide for a more balanced competition, while ". . . at the same time strengthening u.h.f. generally by increasing the number of *'islands'* of permanent u.h.f. stability . . ." the Commission said that it is studying such a plan. (After this statement was made, the Commission announced that it had issued a ruling asking for comments on demixing in some states. See detailed report on demix notice later in this column.)

The statement to Congress also contained some pertinent figures on the number of sets now in operation. Only 5,000,000 of the 35,000,000 TV receivers around, it was noted, are u.h.f.-equipped, and less than 20 per-cent of the chassis now being produced are all-channel models.

"It may well be," explained the Commissioners, "that this lack of u.h.f. receiving equipment, as well as the delay in developing high-power transmitting equipment, have been the most important single factors in the rela-

A mus for af er-dark TV servicing

G-E SERVI-SPOT

Electronic TUBES

- FIND HOUSE NUMBERS!
- READ STREET SIGNS!
- CHECK OUTDOOR ANTENNAS!

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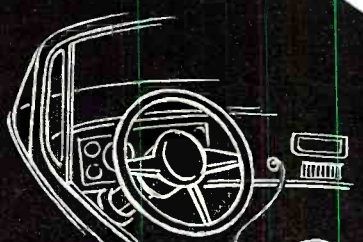
Plugs into the lighter socket on your dash.

Pre-focussed beam carries ¼ mile.

Compact, weighs only 6 oz., 12-ft. cord.

Manufactured by General Electric, world leader in lamps.



Get your SERVI-SPOT from your G-E tube distributor! *General Electric Company, Tube Department, Schenectady 5, N. Y.*

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Now G-E SERVICE-DESIGNED TUBES are available in 14 popular types. Ask your G-E tube distributor for them!

GENERAL ELECTRIC

161-1A3

tive backwardness of u.h.f. development."

The Commission's chill proposal and request to engage in an over-all study of the high-low problem was assailed by the Interstate Committee's chairman, Senator Warren G. Magnuson. Such a freeze, he felt, would create quite a furore in Congress. He believed that most of the major difficulties could be overcome without any authorization stoppage. The failure of the Commission to provide immediate help would, in the Senator's opinion, actually irritate the situation and serve to ". . . soak the American householder."

A SPECTACULAR NEW DEVELOPMENT, providing for the remote control by radar and radio, of jet fighter aircraft on special *drone* missions, pilotless intercept, or nuclear tests, has been disclosed by the Air Research and Development Command.

The system provides automatic takeoff and landings, with exact split-second control at all times, by radio and radar, during climb and dives, cruise, orbiting, or other aerial maneuvers. The ultra-highs are used for radio guidance and command subsystems; they supply tighter precision signals to the drone-fighter craft from jet pilots at *beeper* ground stations or in an accompanying jet director aircraft. And, if all control signals should be cut off while the drone is airborne, due to ground power failure or bomb damage, electronics also comes to the rescue.

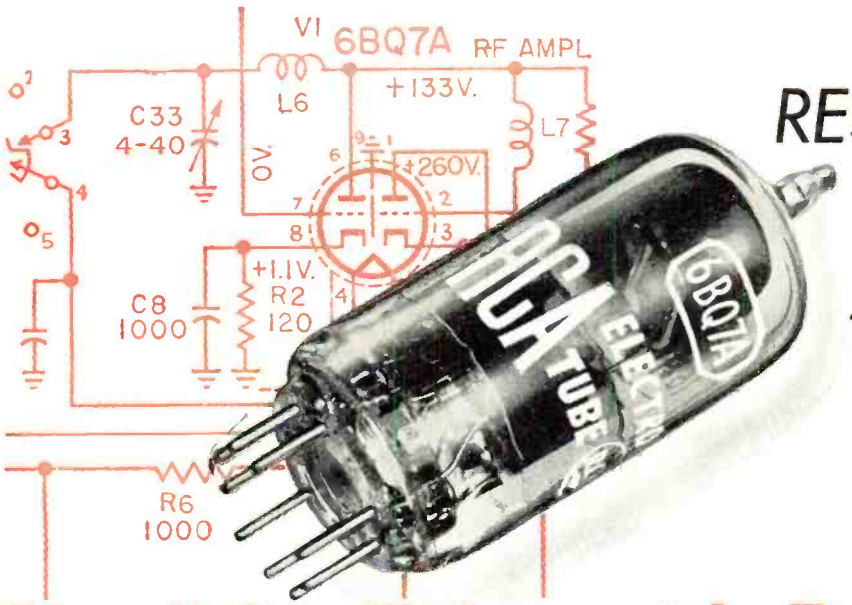
To illustrate, if the plane is below a preselected altitude when carrier signals are shut off, in five seconds, an electronic brain takes over the plane controls, and begins a full-power climb of exactly 7 degrees, retracts dive flaps if these were extended, and at 200 miles per hour changes to a climbing turn to the left, until proper altitude is reached. Then it engages altitude control and continues a left-turn orbit at 265 miles per hour at this constant level and p sition until a signal is restored to gu de the aircraft back for normal landing procedures.

When the plane is above a selected altitude or might be in a critical takeoff climb when a signal shut-off occurs, the safety control takes over and required measures are effected to produce a station-keeping orbit at proper altitude.

THE FIRST STEP in providing worldwide navigational information to military and commercial aircraft is now underway at Camden, N. Y. Here, using a new long-range system called "Navarho", developed by the Air Research and Development Command Headquarter's Rome Air Development Center, three 15-kilowatt transmitters will beam information, *via* three 625-foot towers, in all directions over a distance of 2500 to 3000 miles.

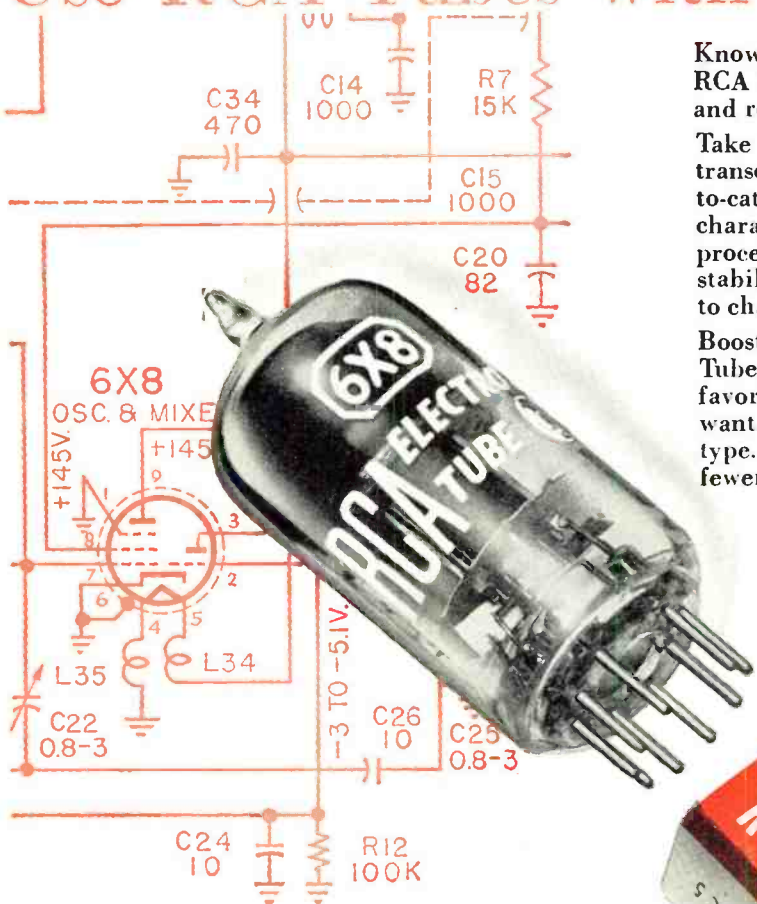
According to Major General Stuart P. Wright, Commander of the Center,

(*Continued on page* 108)



RESTORE THE "HOP" IN TV TUNERS...

Use RCA Tubes with Built-In Quality!



Known for their stability and background "quietness," RCA Tubes help boost the sensitivity of your tuner and reduce tuner noise.

Take the RCA-6BQ7A. Here is a tube having high transconductance, low input capacitance, low plate-to-cathode capacitance, and remarkable uniformity of characteristics—made possible by exacting control procedures during manufacture. Benefits: Greater stability, less receiver noise, higher gain—all the way to channel 13.

Boost the performance of that TV tuner—with RCA Tubes. Next time . . . and every time . . . tell your favorite distributor's counterman or salesman you want genuine RCA Receiving Tubes *only*—type for type. You'll see the difference in better performance, fewer call-backs, and happier customers!

RADIO CORPORATION of AMERICA

ELECTRON TUBES HARRISON, N.J.

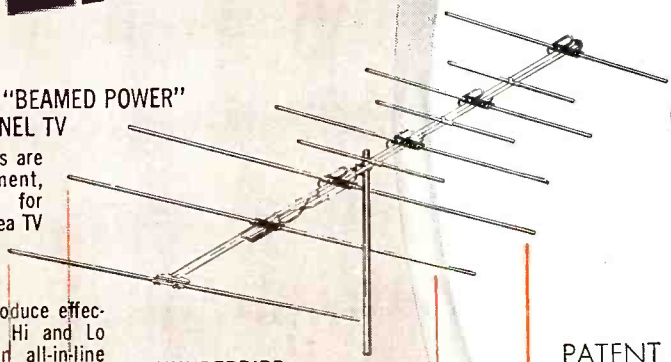
Your First Choice for TV circuits . . . dependable RCA Tubes.

AGAIN *telrex* OFFERS MORE BECAUSE...

THERE IS A MATERIAL DIFFERENCE!

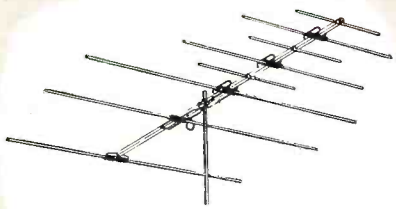
NEW "THUNDER BIRD" "BEAMED POWER" ARRAYS FOR ALL-CHANNEL TV

"THUNDER BIRD" Antennas are loop phased, multi-element, "Beamed Power" Arrays for fringe and "sub-fringe" area TV reception. Element functions are duplexed by means of variable impedance phasing loops to produce effective high gain Yagis for Hi and Lo channel VHF Bands in an all-in-line array which actually produces superior gain and directivity — element for element — than equivalent separate units.

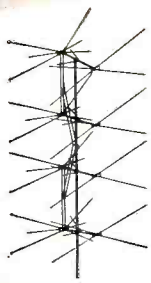


THUNDERBIRD MODEL T120

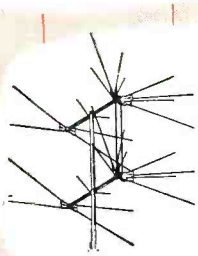
PATENT PENDING *



MODEL T110 THUNDERBIRD

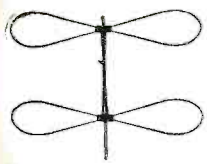


"8X-TV"—the Finest Fringe Area All-Channel Array ever Produced



"DUO-BAND" offers Sensational In-line Directivity and Gain on VHF and UHF

"MODEL 84" covers Full UHF Range at Highest Signal-to-Noise Ratio and Maximum F/B Ratio



"CLOVER-V-BEAM" a Real Performer, Low Cost and Inconspicuous, Configuration Ideal for Second Set Installations

• Top quality materials and construction plus superior performance is the TELREX watchword. Superb engineering combined with exhaustive laboratory and field testing assures reception quality that surpasses factory ratings. Over 100 different models are available to solve every installation problem, whether it be low cost or extra performance. Best quality materials assure peak performance rain or shine.

Producers of famous "BEAMED POWER" Communication Rotaries. Call or write for new catalogs on TV Antennas, Commercial Arrays or Amateur Rotaries.

See the new TELREX Exhibit at the Parts Show! Visit us at Booth 223, Electronic Parts Show Conrad Hilton Hotel, Chicago, May 16th to 19th inclusive.

telrex INC.

AMERICA'S OUTSTANDING TELEVISION BEAM

"CONICAL-V-BEAMS"

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Tel. PRospect 5-7252

Canadian Distributor:
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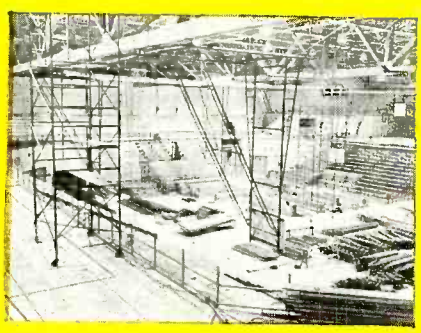
*"Conical-V-Beams" are produced under U. S. Patent No. 23,346, Canadian Patent No. 500,436 and British Patent No. 691,485 — other patents pending. Sold only through authorized distributors.

No dead spots No hot spots

Partial view of CDP installation at modern Lincoln Fields Race Track, located just south of Chicago at Crete, Illinois

OFF AXIS and ON AXIS
Coverage is Clear, Penetrating, Uniform

CDP®
COMPOUND DIFFRACTION PROJECTOR*



Electro-Voice CDP Public Address Loudspeaker System was chosen for the 8,248 seat North Side Gym, Elkhart, Indiana, one of the nation's largest high school gyms. Cluster of stacked CDP's can be seen in photo taken during construction.

Model 848 CDP. 25 watts, 16 ohms. Conservatively rated ±5 db from 175 to 10,000 cps. Crossover at 1000 cps. Variable polar patterns. Size: 10½ in. wide, 20½ in. high, 20 in. deep over-all. List Price: $69.50 **Net Price: $41.70**

Outdoors or indoors, everyone can comfortably hear everything when you use the CDP. Listeners off the axis, where the majority of audiences are, do not have to strain to hear, while those on the axis are not assaulted by blasts of sound. The CDP provides smooth peak-free wide-range response, with 120° sound distribution at all frequencies up to 10,000 cps. Unit energy is far more efficient—there's no wasted power. You can do a better job with fewer units at less cost. CDP utilizes two coaxially mounted diffraction horns, working from both sides of a single diaphragm, plus optical slit diffraction for smooth sound dispersion. CDP delivers 2½ octaves more musical range than comparative units. Molded of glass fibers, CDP is weather-proof, blast-proof, splash-proof. Compare the CDP with any other unit in the environment in which it actually will be used—in the field or in an auditorium. Prove to yourself why it is so superior, why it is the best value ever!

*Pat. D169,904 and Pat. Pend.

Send for CDP Public Address Handbook Bulletin No. 195. Gives complete and helpful information.

NO FINER CHOICE THAN

Electro-Voice®

ELECTRO-VOICE, INC. • BUCHANAN, MICHIGAN

Export: 13 East 40th St., New York 16, U.S.A. Cables: Arlab

Black and White TV • Color TV • Transistor Radios • AM Radios

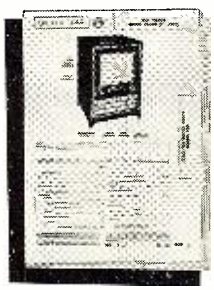
WHAT'S YOUR SERVICE PROBLEM?

FM Radios • Amplifiers and Tuners • Auto Radios • Record Changers

PHOTOFACT HELPS YOU SOLVE IT

FASTER, EASIER, BETTER, MORE PROFITABLY!

THE WORLD'S FINEST SERVICE DATA



PHOTOFACT Service Data is the *only* service information based upon first-hand examination of the actual production-run receivers and equipment. It is authentic, uniform data developed through actual study and analysis by service engineers in the Howard W. Sams Laboratories. PHOTOFACT is the *only data* prepared from the practical point of view of the Service Technician.

Thousands of Service Technicians use PHOTOFACT daily for time-saving, profit-boosting service operations. If you've never used PHOTOFACT, you've never realized your full earning power—you've never given such complete customer satisfaction. So get the proof for yourself. Try PHOTOFACT—use it on any job. Your Parts Distributor has the Folder Sets you need for any of the 17,000 TV and radio receivers, changers, recorders, etc., covered in PHOTOFACT. Once you use this great service, we know you'll want the complete PHOTOFACT Library.

ONLY $25 DOWN

Puts a Photofact Service Data Library in Your Shop. Ask Your Photofact Distributor—He Has the Full Easy-Pay Details.

THESE GREAT FEATURES ARE EXCLUSIVE IN PHOTOFACT—THEY HELP YOU EARN MORE DAILY, HELP INSURE CUSTOMER SATISFACTION

FULL SCHEMATIC COVERAGE

1. Famous "Standard Notation" uniform symbols are used in every schematic.
2. The same standard, uniform layout is used for each schematic.
3. Diagrams are clear, large, easy to read, easy to handle.
4. Wave forms are shown right on the TV schematics for quick analysis by 'scope.
5. Voltages appear on the schematics for speedy voltage analysis.
6. Transformer lead color-coding is indicated on the schematic.
7. Transformer winding resistances appear on the schematic.
8. Schematics are keyed to photos and parts lists.

FULL PHOTOGRAPHIC COVERAGE

9. Exclusive photo coverage of all chassis views is provided for each receiver.
10. All parts are numbered and keyed to the schematic and parts lists.
11. Photo coverage provides quicker parts identifications and location.

ALIGNMENT INSTRUCTIONS

12. Complete, detailed alignment data is standard and uniformly presented in all Folders.
13. Alignment frequencies are shown on radio photos adjacent to adjustment number—adjustments are keyed to schematic and photos.

TUBE PLACEMENT CHARTS

14. Top and bottom views are shown. Top view is positioned as chassis would be viewed from back of cabinet.
15. Blank pin or locating key on each tube is shown on placement chart.
16. Tube charts include fuse location for quick service reference.

TUBE FAILURE CHECK CHARTS

17. Shows common trouble symptoms and indicates tubes generally responsible for such troubles.
18. Series filament strings are schematically presented for quick reference.

COMPLETE PARTS LISTS

19. A complete and detailed parts list is given for each receiver.
20. Proper replacement parts are listed, together with installation notes where required.
21. All parts are keyed to the photos and schematics for quick reference.

FIELD SERVICE NOTES

22. Each Folder includes time-saving tips for servicing in the customer's home.
23. Valuable hints are given for quick access to pertinent adjustments.
24. Tips on safety glass removal and cleaning.

TROUBLE-SHOOTING AIDS

25. Includes advice for localizing commonly recurring troubles.
26. Gives useful description of any new or unusual circuits employed in the receiver.
27. Includes hints and advice for each specific chassis.

OUTSTANDING GENERAL FEATURES

28. Each and every PHOTOFACT Folder, regardless of receiver manufacturer, is presented in a standard, *uniform* layout.
29. PHOTOFACT is a *current* service—you don't have to wait a year or longer for the data you need. PHOTOFACT keeps right up with receiver production.
30. PHOTOFACT gives you *complete* coverage on TV, Radio, Amplifiers, Tuners, Phonos, Changers.
31. PHOTOFACT maintains an inquiry service bureau for the benefit of its customers.

FREE **PHOTOFACT CUMULATIVE INDEX**

Send for it! Your guide to virtually any model ever to come into your shop; helps you locate the proper PHOTOFACT Folder you need to solve any service problem on any model. Once you have the make and chassis number, it takes just 60 seconds to find the applicable PHOTOFACT Folder. Send coupon now for your FREE copy of the valuable Cumulative Index to all PHOTOFACT Folders.

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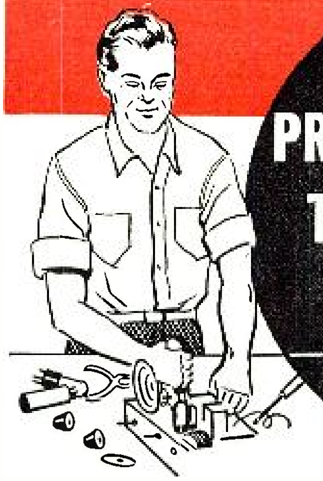
RADIO & TELEVISION NEWS



KEEP YOUR PRESENT JOB AND TRAIN TO BE A TELEVISION TECHNICIAN

Step Into a Higher Paying Position Without Giving Up Your Present Income

L. C. Lane, B.S., M.A. President, Radio-Television Training Association. Executive Director, Pierce School of Radio & Television.

I'll train you at HOME in your SPARE TIME

If you're now working as a Radio Technician, Maintenance Man, or Operator you can keep your job while studying one of my two NEW and UP-TO-THE-MINUTE Courses — FM and Television Technician Course — TV Cameraman and Studio Technician Course.

These Courses — especially prepared for home study—will prepare you for top-paying jobs in the ever-expanding radio-television-electronics industry.

EXPERT FM-TV TECHNICAL TRAINING

My FM-TV Technician Course lets you take full advantage of your previous experience — either civilian or Armed Forces. YOU CAN SAVE MONTHS OF TIME. My FM-TV Technician Course completes your training by providing a thorough background in Frequency Modulation and Television Theory and Practice.

You "Learn by Doing", working with parts and equipment I send you. Six large kits of FM and TV parts are given to you as part of the course. You build and keep a professional GIANT SCREEN TV RECEIVER complete with big picture tube (designed and engineered to take any size up to 21-inch).

Upon completion of your training you may — if you desire — take two weeks of shop training at my associate resident school in New York City AT NO EXTRA COST!

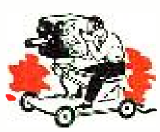
FREE FCC COACHING COURSE

Important for BETTER PAY JOBS requiring FCC License. You get this training AT HOME and AT NO EXTRA COST. Top TV jobs go to FCC-licensed technicians.

VETERANS!

My School fully approved to train veterans under new Korean G.I. Bill. Write discharge date on coupon.

PRACTICAL TV CAMERAMAN & STUDIO COURSE



My TV Cameraman and Studio Course is designed to train TV Studio Technicians and TV Cameramen, urgently needed today by Television Broadcasting Stations throughout the nation. New TV Stations are now mushrooming throughout the country. Men who can work as Audio Technicians, TV Cameramen, Microphone Boom Operators, Monitor Operators, Turntable Operators, Control Room Technicians can write their own tickets.

I will train you for an exciting high pay job as the man behind the TV camera. Work with TV stars in TV studios or "on location" at remote pick-ups.

Available if you want it . . . one week of actual work with studio equipment and TV Cameras at my associate resident school in New York City.

This course is a MUST for those who wish to increase their technical knowledge of television operations.

EARN WHILE YOU LEARN

Almost from the very start you can earn extra money while learning, repairing Radio-TV sets for friends and neighbors. Many of my students earn up to $25 a week . . . pay for their entire training from spare time earnings . . . start their own profitable service business.

TRAINING FOR BEGINNERS

My Radio-FM-Television Technician Course is especially prepared for men with *no previous experience* or *training*. I have trained hundreds of men for successful careers in radio-television-electronics. Many of them had only a grammar school education and no previous experience whatsoever in the field.

Two weeks of intensive shop practice at my associate resident school is also included with this Course.

YOU GET THESE FOUR FREE!

MAIL THIS COUPON TODAY!

no salesman will call!

Mr. Leonard C. Lane, President Dept. T-6
RADIO-TELEVISION TRAINING ASSOCIATION
52 East 19th Street, New York 3, N. Y.

Dear Mr. Lane: Mail me your NEW FREE BOOK, FREE SAMPLE LESSON, and FREE aids that will show me how I can make BIG MONEY IN TELEVISION. I understand I am under no obligation and no salesman will call.

(PLEASE PRINT PLAINLY)

Name__________ Age____

Address__________

City__________ Zone____ State____

I AM INTERESTED IN:

- ☐ Radio-FM-TV Technician Course
- ☐ FM-TV Technician Course
- ☐ TV Cameraman & Studio Technician Course

VETERANS! Write discharge date ________

Radio Television Training Association

52 EAST 19th STREET • NEW YORK 3, N. Y.

Licensed by the State of New York • Approved for Veteran Training

Within the INDUSTRY

WALTER S. LEFEBRE, a familiar figure in the radio and television industry for more than 30 years, has retired as a member of the radio and television division of *Sylvania Electric Products Inc.*

Prior to his retirement, Mr. Lefebre was the division's market development manager. He joined the *Sylvania* organization in 1950 as a field sales manager of the division and subsequently became a district sales manager, servicing such territories as Pittsburgh, Cleveland, Philadelphia, Syracuse, and Buffalo.

He began his career in the industry in 1923 as a manufacturer of loudspeakers. In 1929 he joined the sales staff of *National Union Radio Corp.* and five years later joined *Philco.* He was also associated with *Westinghouse* as assistant sales manager for radio.

* * *

WESTINGHOUSE ELECTRIC CORPORATION has announced plans to construct a combined manufacturing plant, engineering, and office building for the production of military electronic equipment near Friendship Airport, Baltimore, Maryland. Plans call for full occupancy and operation by January of next year . . . Ground has been broken for the new West Coast plant of **FAIRCHILD CAMERA AND INSTRUMENT CORPORATION** which will be situated on a six-acre site on East Washington Boulevard adjacent to the Santa Ana Freeway in Los Angeles. The plant will provide expanded manufacturing facilities for the firm's potentiometer division . . . **HENRY P. SEGEL COMPANY, INC.,** Boston manufacturers' representative firm, will construct a modern, air-conditioned building at 384-386 Washington St., Brookline, Mass. The new location will provide a large parking area for customers in addition to offering extensive display space for a complete line of electronic equipment . . . A new plant, to be located at 5121 San Fernando Road, Los Angeles, will house all divisions of the **ELECTRONIC SPECIALTY COMPANY,** manufacturers of airborne electronic equipment . . . **PACE ELECTRICAL INSTRUMENT CO., INC.,** the meter manufacturing division of **PRECISION APPARATUS,** is now occupying a new plant at 70-31 84th Street, Glendale 27, Long Island, N. Y. . . . The transfer of all operations to a new plant at Lexington, Ohio has been announced by **STEVENS MANUFACTURING COMPANY, INC.** The new plant at 45 North Plymouth Street is a single-story structure of 31,000 square feet . . . **WARD TERRY AND COMPANY** of Denver has recently opened a new $250,000 electronic parts division at 70 Rio Grande Boulevard. The firm handles **RCA** products in Denver . . . **HYCON MFG. COMPANY** has purchased a 67-acre industrial property in LaVerne, California, adjoining the Pomona Fair Grounds. The property will be used for a new plant . . . **SYLVANIA ELECTRIC PRODUCTS INC.** has selected a location in the town of Camillus, N. Y., near Syracuse, as the site of the company's new data processing center. A 50,000 square foot building will be erected shortly . . . Plans to acquire two large manufacturing plants, one in Cleveland and one in Detroit, were announced by **THOMPSON PRODUCTS, INC.,** producer of automotive, aircraft, and electronic parts. The chassis plant in Detroit will be built this year while the Cleveland property is one acquired from **WHITE MOTOR CO. . . . RADIO CORPORATION OF AMERICA** has dedicated its new Aviation Systems Engineering Laboratory in Waltham, Mass. Approximately 100 scientists, engineers, and laboratory personnel will be employed at the new facility by the end of the year . . . **TENSOLITE INSULATED WIRE CO. INC.** of Tarrytown, N. Y. has recently completed new plant additions which have doubled the firm's production capacity at 196 Main Street.

* * *

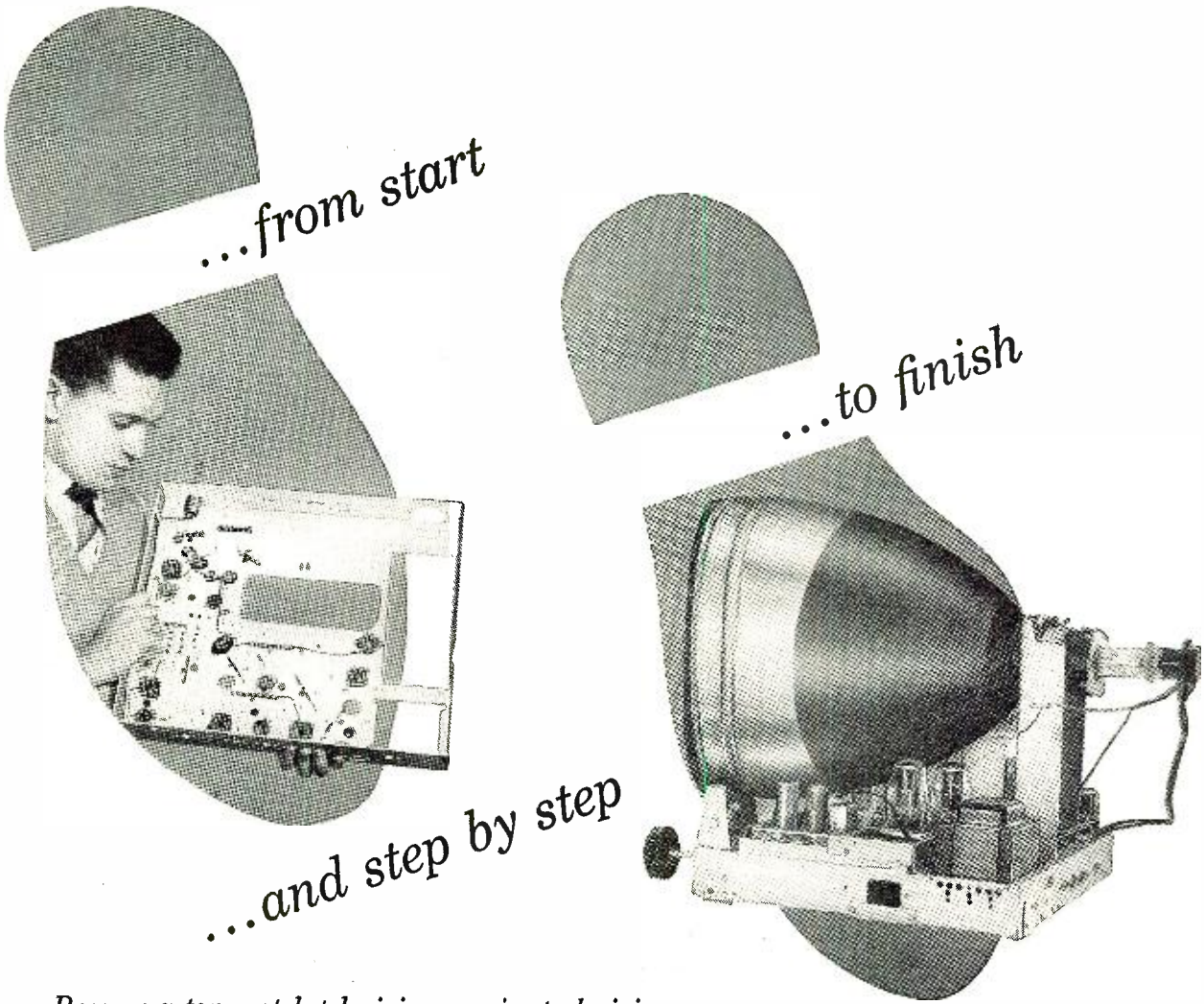
MILTON S. PAGE has been named to the post of sales engineer for the Technical Sales Department of *Allen B. Du Mont Laboratories, Inc.*

He has been assigned to the company's Tube Research Laboratory where he will participate in the expanding sales activity of the company's multiplier phototubes and special cathode-ray tubes to government and private industry as well as sales of the company's regular line of cathode-ray oscillographs and other electronic instruments.

Mr. Page joined the company in 1951 and has served in several technical capacities.

* * *

ERIE RESISTOR CORPORATION has announced the formation of a new division for the engineering and production of special electrical, electronic, and mechanical assemblies. The new division is located in Erie, Pa. . . . The Instrument Division of **ALLEN B. DU MONT LABORATORIES, INC.** has established a Systems Engineering group to assist industry by the application of



Become a top-notch television service technician

Now . . . RCA INSTITUTES offers modern TV KIT with Comprehensive Television Servicing Course

START to build with a TV Kit developed by one of America's foremost radio-tv schools—RCA Institutes. LEARN with simple step-by-step instruction how to build a modern, large-screen receiver. TEST each stage, *as you build,* and see how it works. Learn how "trouble-shooting" is applied. FINISH your Home Study Course ready and able to service all make and model sets!

Easy-to-follow instructions are planned and prepared for you through the efforts of RCA Institutes' instructors, engineers at RCA Laboratories, and training specialists of the RCA Service Company.

The RCA Institutes' TV Kit utilizes up-to-date circuits including:

- *Synchro-Guide horizontal automatic frequency control circuit.*
- *Horizontal magnetic reaction scanning.*
- *Latest deflection circuits.*
- *FM sound discriminator.*
- *High-gain, low-noise cascode tuner.*

Join the many thousands who have been successfully trained by RCA Institutes for a good job (or business of their own) in television servicing.

BASIC KNOWLEDGE OF RADIO NECESSARY
NO NEED FOR PREVIOUS TV TRAINING

FREE BOOKLET! MAIL COUPON NOW.

RCA INSTITUTES, INC., Home Study Dept. NK-6-55,
350 West Fourth Street, New York 14, N.Y.
With no obligation on my part, please send me a copy of your booklet on the TV Servicing Home Study Course and Kit. I understand no salesman will call.

Name:_____
(Please print)

Address:_____

City:_____ Zone:_____ State:_____

RCA®

RCA INSTITUTES, INC.
A SERVICE OF RADIO CORPORATION of AMERICA
350 WEST FOURTH STREET, NEW YORK 14, N.Y.

electronic techniques to automatic production and quality control methods. The activity will headquarter at the Clifton, N. J. plant of the company . . . A new automation division for design and engineering connected with the manufacture of electro-mechanical assemblies has been announced by the **RADIO CONDENSER COMPANY** of Camden 3, N. J. . . . **INLAND AUTOMATIC, INC.** has been set up at 1108 Jackson Street, Omaha 8, Nebraska to serve electronic and parts manufacturers who require automatic screw machine precision parts of difficult-to-machine materials. Dept. E-9 of the firm will handle all requests from manufacturers . . . **THE BRUBAKER MANUFACTURING COMPANY** has changed its name to **BRUBAKER ELECTRONICS, INC.** The firm has plants in Los Angeles and Culver City.

* * *

NATHAN CHIRELSTEIN, chairman of the board of *Allied Electric Products, Inc.* and its division, *Sheldon Electric Co.,* died recently after a short illness following a heart attack. He was 55 years old.

In 1923 he founded the *Sonatron Tube Co.* and six years later that firm was merged with three other companies to form the *National Union Radio Corp.* of which he became president. He resigned this post in the early 1930's and founded *Allied* in Newark, N. J. The firm later moved to Irvington and now has a branch factory in Los Angeles.

* * *

INTERNATIONAL RESISTANCE COMPANY has announced the acquisition of the **HYCOR COMPANIES** of California and Puerto Rico. The new subsidiaries will continue to operate independently . . . **TOPP INDUSTRIES, INC.** of Los Angeles has merged with **BONNER MACHINE WORKS, INC.** through an exchange of outstanding stock. The merged companies will retain the name of **TOPP** . . . **ELECTRONIC SPECIALTY CO.** of Los Angeles has acquired a controlling interest in **ELECTROMEC, INC.** of Burbank, California, which will be operated as a subsidiary of the parent firm . . . **JORDAN ELECTRONIC MFG. CO., INC.** of Pasadena, California, has been acquired by **PANELLIT, INC.** of Chicago and will be operated as a wholly-owned subsidiary. A new plant for the subsidiary is being built in Alhambra, California . . . Plans for the merger of **DAYSTROM, INCORPORATED** and **WESTON ELECTRICAL INSTRUMENT CORPORATION** have been announced . . . **ACME ELECTRONICS, INC.** has merged with the Pacific Coast Division of **AEROVOX CORPORATION** and will henceforth operate under the latter company's name. Both of the former operations will be carried on at the division's 50,000 square foot plant in Monrovia, California . . . **ASKANIA REGULATOR COMPANY** has acquired the good-will and physical assets of **HEINZ ENGINEERING COMPANY** of

(*Continued on page* 118)

SYLVANIA SILVER SCREEN 85

he picture tube with Selling Power

That's right! Sylvania's "Silver Screen 85" puts powerful, profitable salesmanship behind your personal TV service. That's because "Silver Screen 85" is the picture tube TV America knows and asks for by name.

Every week Sylvania's "Beat the Clock" show builds greater consumer recognition and demand for the "Silver Screen 85." Every week dealers benefit at the payoff point.

Put the "Silver Screen 85's" selling power to work for you. This booklet tells your customers the benefits of Sylvania's "Silver Screen 85." Leave a copy on every service call. Order a free supply now from your Sylvania Distributor.

SYLVANIA ELECTRIC PRODUCTS INC.
1740 Broadway, New York 19, N. Y.
In Canada: Sylvania Electric (Canada) Ltd.,
University Tower Building, Montreal
LIGHTING • RADIO • ELECTRONICS
TELEVISION • ATOMIC ENERGY

"Installing a 'Silver Screen 85' sure increases the value of a trade-in set and speeds turnover."

"'Silver Screen 85' sales are up over all other brands."

"TV service volume increased by 'Silver Screen 85' tie-in advertising."

SYLVANIA®

. . . fastest growing name in sight

LAFAYETTE'S SPECTACULAR MONEY SAVERS

A BUY OF A LIFETIME
PORTABLE ELECTRONIC MEGAPHONE and AMPLIFIER SYSTEM

ALL THREE UNITS ONLY 89.50

COST U.S. NAVY ~~$1850.00~~ YOURS FOR ONLY $89.50

- Powerful 20 watt amplifier!
- Pistol grip dynamic megophone!

All Units BRAND NEW and GUARANTEED

A complete portable 20 watt amplifier system at a fractfon of its original cost! Quality is unquestionable—designed and built for the U. S. Navy! Use on fishing boats—pleasure craft—traffic control—parking lots—day camps—carnivals—sports events—life saving stations—any place where handling large crowds; or reaching large audiences is necessary. Unit operates from self contained rechargeable batteries—no power line connections necessary. May be set up permanently when used with charging rack. System consists of a 20 watt 6 tube amplifier—in a waterproof portable metal case, an electronic megaphone, a battery charger power unit that operates on 110 volts AC/DC and on 12, 24, 48, or 96 Volts DC, 3 cell 6 volts storage battery, tubes, cables, plugs and 30 page instruction and diagram book. Overall size complete 15½"x13"x12". Shpg. wt. 88 lbs.

ELECTRONIC MEGAPHONE SYSTEM.....Net 89.50

Lafayette Greatest Tape Buy Ever!

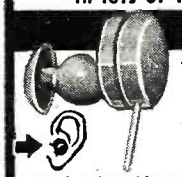
$1.89 per roll plus postage (COD's accepted)

1200 FT. REEL
Genuine Plastic Base
RECORDING TAPE
Shpg. Wt. 14 oz.

LAFAYETTE made a terrific deal with one of the leading manufacturers of recording tape to supply us with their regular tape which sells for almost twice our price. WE GUARANTEE ABSOLUTE SATISFACTION OR YOUR MONEY BACK. The finest, professional-quality recording tape obtainable. Highest performance for thousands of playings. Red Oxide Base in a smooth, uniform coating; greater signal strength; with maximum fidelity; uniform frequency response from 40-15,000 cps.

In lots of 10 rolls - 1.75 ea

LAFAYETTE EXCLUSIVE! DYNAMIC EAR PHONE



A new lightweight plastic ear phone especially imported by Lafayette to bring you the high quality of a dynamic ear phone with the ease and comfort of an almost weightless unit—at a price less than half that of any comparable unit. Fits right into ear. Excellent sensitivity of 65 db. Ideal for use with miniature sets, hearing aids, transcribing, etc. DC resistance 2000 ohms, impedance 5000 ohms at 1000 cycles. Complete with 3 ft. plastic covered cord.

MS-72.....Net 1.95

LOW IMPEDANCE MODEL FOR SILENT LISTENING OR VIEWING

Will replace speaker on any radio set or T.V for silent listening, by direct connection to secondary of output transformer. Impedance 8 ohms.

MS-100.....Net 1.95

SALE

ASTATIC UHF CONVERTER

channels 14 thru 83

In Lots of 3.... 13.95
Singly, each..... 14.45

Below manufacturer's cost! Continuous vernier tuning—14 thru 83. Operates into TV receiver channels 2-3-4-5 and 6! Two stage preselector. Fully shielded spiral inductance tuner reduces oscillator radiation. Uses 6AF4 or 6T4 and IN82 crystal diode. High sensitivity—low noise performance!

ASTATIC UHF— Singly, each..... 14.45
In lots of 3, each..... 13.95

MINIATURE CRYSTAL MICROPHONE

Here's a typical Lafayette special for the experimenter, student or dealer. An extremely sensitive and small crystal microphone used in hearing aids and other small apparatus. Can be used as lapel mike—miniature transmitter mike for concealed locations, etc. Its size and performance gives it joint versatility. Brand new. Size only 1⅜" Diam. x 5/16" deep. Imported to save you money.

MS-108.....Net 1.95

REAR SEAT AUTO SPEAKER KIT

HEAVY DUTY 6" x 9" PM KIT

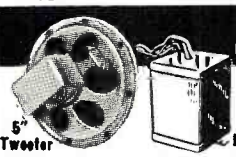
A complete kit for adding another speaker in the rear of your car. You get a 6"x9" PM speaker with a 2.15 oz. Alnico V magnet; a CRL PK300 three position switch so you can select either speaker alone or both together, dial plate with mounting bracket, knob and hardware; a plastic grille (illustration A) (your choice of brown, grey or silver), wire and wiring instructions. Simple to install. Shpg. Wt. 4 lbs.

SK-36.....Net 4.50

DELUXE 6" x 9" KIT

SK-37, with chrome plated metal grill (Fig. B).
Shpg. Wt. 5 lbs.....Net 5.75

5" Tweeter AND Crossover Network



7.95

A specially designed 5" Tweeter and Crossover Network that will assure high frequency response when used with any speaker you now possess. You can now make your present speaker into a 2-way speaker system increasing the high frequency range up to 15,000 cycles. Diagram included. Shpg. Wt. 5 lbs.

STOCK NO. SY-14.....Net 7.95

DUAL STYLUS — TRIPLE PLAY

11.95

DIAMOND and SAPPHIRE (LP) (78)

LIST ~~$31.00~~

Replacement for All G.E. RPX-050 Triple-Play Cartridges!

Stock No. PK-29 Net 11.95

Masco CASCADIAN TV BOOSTER

Reg. Price ~~$42.50~~

SALE 9.5

Biggest Booster Buy Ever!

Famous Masco Cascade Booster!!

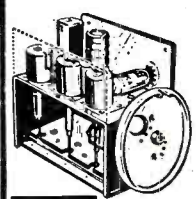
- Three tuned circuits—cascode!
- Golden Grid 6BZ7 Plus 6J6 Plus rectifier!
- 35 db gain (56 times!) average on all channels!

A sensational new tunable VHF booster utilizing a special low-noise circuit. Employs the new Golden Grid 6BZ7 tube so well known for its use in cascode circuits. Field pioneer and specifically designed for new low noise-high gain front ends. Brings superior reception to older type receivers. Single knob control for utmost simplicity of operation. Signal strength is increased at least 56 times—35 db!—average on all channels. Rack and pinion permeability for precision stability. Automatically switched on and off by TV set. Uses cross-neutralized 6J6 and 6BZ7 tubes for maximum gain and bandwidth. U/L approved. For 110 volts AC. Wt. 5 lbs.

Masco TVB-53. In lots of 3, Net 9.45 Singly, ea. 9.95

SALE RADIO RECEPTOR UHF CAVITUNER

Complete with 6 AF4, 6BZ7 and IN82



4.95

Tunes all UHF channels 14-82. Most advanced engineering, three cavities, two used as bandpass pre-selector, one controlling local oscillator. Features frequency stability, uniformly broad bandwidth, high selectivity, low noise, high gain. Completely shielded. Ideal for building convertors, etc. Size 3½" H x 4¾" W x 4⅜" D. Shpg. Wt. 4½ lbs.

TL-26...Lots of 3, ea. 4.45
Singly, ea. 4.95

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Prism-Coated Lenses

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- Individual Focus
- Leather Case & Straps

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F-15 —7X,35 I.F.	Net 19.95	
F-103—7X,50 I.F.	Net 21.95	
F-117—10X,35 C.F.	Net 23.95	
F-104—12X,50 I.F.	Net 32.50	
F-118—16X,50 C.F.	Net 34.95	

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10 DAY FREE TRIAL—MONEY BACK GUARANTEE

39.50

QUALITY BUILT FOR YEARS OF OUTSTANDING PERFORMANCE

- Completely self contained unit—including batteries slips into breast pocket.
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- Continuously variable volume control.
- 3 position tone Control

Modern! Powerful! Tiny! As small as a pack of cigarettes! Only 3½"x2⅜"x⅞". And only ⅛ the usual price for an instrument of this quality. Weighs only 5 ozs.—including the batteries! No extra bag or pouch to carry—batteries are inside the unit. Guaranteed to suit your particular hearing problem. Only Lafayette's purchasing power makes this price possible—backed by their amazing Warranty. No charge replacement on any defective part (except cords and batteries) due to normal usage for 1 year from date of purchase. Complete with batteries and carrying case.

HA-100.....Net 39.50

INDUCTION MODEL

Identical to HA-100, but has built in induction coil for use with telephone.

HA-101.....Net 49.50

FREE send for it

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GET LAFAYETTE'S NEW CATALOG PACKED WITH THE LARGEST SELECTION OF QUALITY ELECTRONICS EQUIPMENT AT BARGAIN PRICES.

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no finer tubes
than CBS tubes...
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are going to ask for
the tubes with the
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Guaranteed by
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on both TV and Radio
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PICKERING models 220/240 cartridges

The Most Nearly Perfect Phono Pickups Ever Produced

. . . they are sold separately for all standard arms or mounted back-to-back to make up the famous PICKERING 260 TURNOVER PICKUP.

MODEL 220—for 78 rpm records diamond or sapphire stylus

MODEL 240—for 33⅓ and 45 rpm records diamond stylus only

MODEL 260—turnover cartridge for 78 or 33⅓ and 45 rpm records (the 220 and 240 back-to-back)

The 220 and 240 are engineered to maximize performance. By comparison they are without equal . . .

The **220** *and* **240** *are*

Lighter—5½ grams

Smaller—⅝ by ¾ by ⅜ inches

The **220** *and* **240** *have*

Highest Output—30 millivolts/10cm/sec.

More Compliance with Less Tracking Force

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These characteristics have real meaning to those who understand that maximum performance depends upon components which meet professional standards. If you want the best that high fidelity can offer, ask your dealer to demonstrate the 220, 240 and 260 Pickering cartridges . . .

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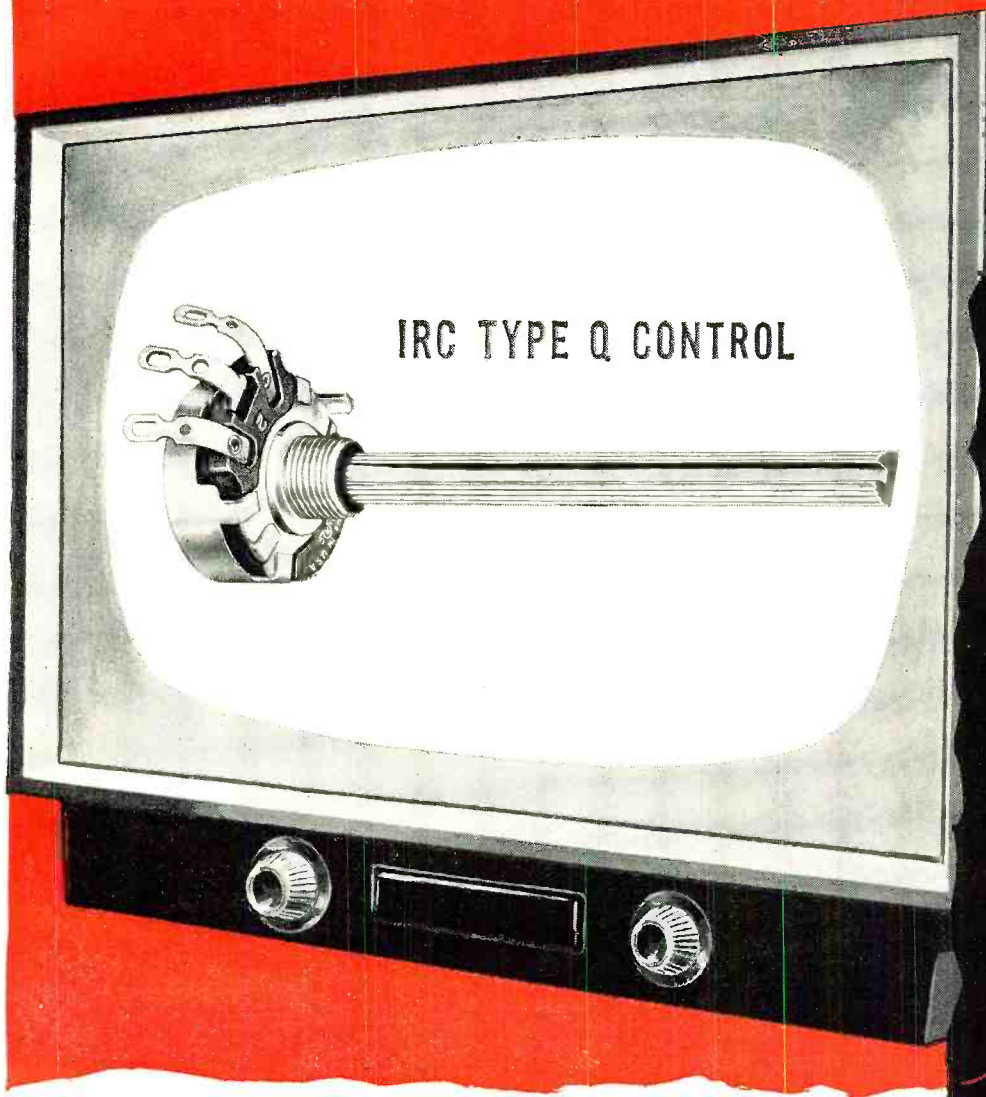
PICKERING COMPONENTS ARE PROFESSIONAL QUALITY

"For those who can hear the difference"

. . . Demonstrated and sold by Leading Radio Parts Distributors everywhere. For the one nearest you and for detailed literature; write Dept. C-7,

Preferred for modern set servicing



KNOBMASTER FIXED SHAFT
Q Control standard shaft is knurled, flatted and slotted —fits most knobs without alteration.

INTERCHANGEABLE FIXED SHAFTS
Exclusive IRC convenience feature—provides fast conversion to "specials", with FIXED shaft security. 15 types available.

1/4" LONG BUSHING
Accommodates all small sets, yet handles large set needs perfectly.

7 STANDARD TAPERS
Full coverage of all taper requirements is provided in the Q Control.

94 RESISTANCE VALUES
For TV, AM and FM coverage, 94 values of plain and tapped controls are furnished.

QUALITY APPEARANCE
The handsome professional appearance of IRC Q Controls lets you point to your work with pride.

CUSHIONED TURN
The smooth, quality of "feel" of a Q Control contributes to customer confidence.

TYPE 76 SWITCHES
Either of two type IRC switches attached as quickly and easily as a control cover—meets all your requirements.

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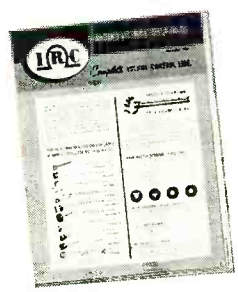

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ALL CRYSTALS TESTED FOR ACTIVITY!
1-DAY SERVICE FOR EVERYTHING IN STOCK!

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FT-243 FUNDAMENTAL FREQUENCIES

Lots of 10 or more. Ea. **99c**

Individually. Ea. $1.25

YOUR CHOICE OF FREQUENCIES!

80 METERS 3701, 3702, 3703 through 3748 in steps of 1 KC.

40 METERS 7176, 7177, 7178 through 7198 in steps of 1 KC.

DOUBLING TO 40 METERS: 3588, 3589, 3590 through 3599 in steps of 1 KC.

SINGLE SIDE BAND—FT-241-A

Low Frequency Crystals **79c**

Lots of 10 or more. Each.....
Lots of 5 or more. Each..... 89c
Individually. Each..... 99c

400	442	446	450	453	456	459	463	466	470	474	477
440	444	447	451	454	457	461	464	468	472	475	479
441	445	448	452	455	458	462	465	469	473	476	480

MISCELLANEOUS & SHIP BAND FREQUENCIES

81.95 KC. Octal tube type (Used in SCR-584 & SPM-1)	$3.99	2670 KC. DC-34	2.99
200 KC. FT-241 CR2/U	1.99	2738 KC. type 1-C	2.99
200 KC. Type DC-15 in octal tube base type holder	1.99	2738 KC. FT-243	2.99
327.8 KC. No. D-168342. (Used in TS-102/AP)	9.95	2738 KC. MC-7	2.99
500 KC. FT-241	1.99	2891 KC. DC-34	2.99
1000 KC. Type DC-9. in octal tube base type holder	3.45	2907 KC. DC-34	2.99
2009 KC. DC-34	2.99	2951 KC. DC-34	2.99
2110 KC. DC-34	2.99	2973 KC. DC-34	2.99
2126 KC. DC-34	2.99	2977 KC. DC-34	2.99
2142 KC. DC-34	2.99	2983 KC. DC-34	2.99
2166 KC. DC-34	2.99	3000 KC. FT-243	2.99
2174 KC. DC-34	2.99	3021 KC. DC-34	2.99
2182 KC. DC-34	2.99	3023 KC. DC-34	2.99
2182 KC. FT-243	2.99	3043 KC. DC-34	2.99
2206 KC. DC-34	2.99	3053 KC. DC-34	2.99
2406 KC. FT-243 & DC-34	2.99	3055 KC. DC-34	2.99
2500 KC. FT-243	1.99	3088 KC. FT-243	2.99
2559 KC. DC-34	2.99	3093 KC. DC-34	2.99
2567 KC. FT-243 & DC-34	2.99	3093 KC. FT-243	2.99
2629 KC DC-34	2.99	3098 KC. FT-243	2.99
2632 KC. FT-243	2.99	3103 KC. FT-243	2.99
2637 KC. DC-34	2.99	3123 KC. DC-34	2.99
2647 KC. FT-243	2.99	3125 KC. DC-34	2.99
2658 KC. DC-34	2.99	3188 KC. FT-243	2.99
2638 KC. FT-243	2.99	3193 KC. DC-34	2.99
2670 KC. FT-243	2.99	3193 KC. FT-243	2.99
2647 KC. FT-243	2.99	3198 KC. FT-243	2.99
		3203 KC. FT-243	2.99
		5000 KC. FT-243	1.99
		8250 KC. FT-243 CAP	1.99
		10.000 KC. Type SR-5 Billey, in CR-1 holder	1.99

NUMBERS LISTED ARE FUNDAMENTAL FREQUENCIES IN KILOCYCLES

FT-243

Lots of 10 or more. Ea.....
Lots of 5 or more. Ea....79c
Individually. Ea. 99c **69c**

1110	2520	2910	3320	4695	5825	6375	7125	7533.3	7780	8025	8270	8510
1129	2525	2915	3340	4710	5840	6400	7140	7540	7783.3	8030	8273.3	8516.7
1150	2530	2920	3410	4735	5850	6405	7150	7541.7	7790	8033.3	8275	8520
1195	2535	2925	3420	4780	5852.5	6406.6	7160	7550	7791.7	8040	8280	8525
1525	2545	2930	3455	4785	5860	6425	7173.3	7558.3	7800	8041.7	8283.3	8530
1915	2550	2935	3465	4815	5873.5	6440	7175	7560	7806.6	8050	8290	8533.3
1930	2557	2940	3510	4820	5875	6450	7200	7566.7	7808.3	8058.3	8291.7	8540
1940	2560	2945	3525	4840	5880	6473.3	7206.6	7570	7810	8060	8300	8541.7
1950	2565	2950	3640	4845	5892.5	6475	7225	7573.3	7816.7	8066.7	8306.6	8550
1965	2570	2955	3655	4852.5	5900	6500	7240	7575	7820	8070	8308.3	8558.3
2015	2575	2960	3680	4880	5906.7	6506.6	7250	7580	7825	8073.3	8310	8560
2017	2580	2965	3700	4900	5907.5	6525	7273.3	7583.3	7830	8075	8316.7	8566.7
2020	2585	2975	3760	4930	5925	6540	7275	7590	7833.3	8080	8320	8570
2025	2590	2980	3800	4950	5940	6550	7300	7591.7	7840	8083.3	8325	8573.3
2035	2595	2985	3885	4980	5950	6573.3	7306.6	7600	7841.7	8090	8330	8575
2040	2650	2990	3940	4995	5955	6575	7308.3	7606.6	7850	8091.7	8333.3	8580
2055	2655	2995	3955	5030	5973.3	6600	7316.7	7608.3	7858.3	8100	8340	8583.3
2060	2660	3005	3980	5035	5975	6606.6	7325	7610	7860	8106.6	8341.7	8590
2065	2665	3010	3990	5090	5995	6625	7333.3	7616.7	7866.7	8108.3	8350	8591.7
2090	2680	3015	3995	5127.5	6000	6640	7340	7620	7870	8110	8358.3	8600
2105	2685	3020	4035	5165	6006.6	6650	7341.7	7625	7873.3	8116.7	8360	8606.6
2125	2690	3025	4045	5180	6025	6673.3	7350	7630	7875	8120	8366.7	8608.3
2130	2695	3030	4080	5205	6040	6675	7358.3	7640	7880	8125	8370	8610
2135	2705	3035	4095	5235	6042	6700	7366.7	7641.7	7883.3	8130	8375	8616.7
2140	2710	3040	4110	5245	6050	6706.6	7633.3	7650	7890	8133.3	8380	8620
2195	2715	3045	4135	5285	6073.3	6725	7373.3	7658.3	7891.7	8140	8383.3	8625
2300	2720	3050	4165	5295	6075	6740	7375	7660	7900	8141.7	8390	8630
2305	2750	3055	4175	5300	6100	6750	7383.3	7666.7	7906.6	8150	8391.7	8633.3
2320	2755	3060	4190	5305	6106.6	6773.3	7391.7	7670	7908.3	8158.3	8400	8640
2350	2760	3065	4215	5327.5	6125	6775	7400	7673.3	7910	8160	8406.6	8641.7
2355	2765	3070	4220	5335	6140	6800	7406	7675	7916.7	8163.4	8408.3	8650
2360	2770	3075	4255	5385	6142	6806.6	7406.6	7680	7920	8166.7	8410	8658.3
2365	2775	3095	4280	5397.5	6150	6815	7408.3	7683.3	7925	8170	8416.7	8660
2370	2780	3110	4295	5435	6173.3	6825	7416.7	7690	7930	8173.3	8420	8666.7
2375	2785	3130	4300	5437.5	6175	6840	7425	7691.7	7933.3	8175	8425	8670
2390	2790	3135	4330	5485	6185	6850	7433.3	7700	7940	8180	8430	8673.3
2415	2795	3140	4340	5500	6200	6873.3	7440	7706.6	7941.7	8183.3	8433.3	8675
2430	2815	3145	4395	5545	6206.6	6875	7441.7	7708.3	7950	8190	8440	8680
2435	2825	3150	4397.5	5582.5	6225	6900	7450	7710	7358.3	8191.7	8441.7	8683.3
2440	2830	3155	4445	5587.5	6235	6906.6	7458.3	7716.7	7960	8200	8450	8690
2442	2835	3160	4450	5645	6240	6925	7466.7	7720	7966.7	8206.6	8458.3	8691.7
2450	2840	3165	4490	5660	6250	6940	7473.3	7725	7970	8208.3	8460	8700
2455	2845	3170	4495	5675	6273.3	6950	7475	7730	7973.3	8210	8466.7	8706.6
2460	2850	3175	4535	5687.5	6273.5	6973.3	7483.3	7733.3	7975	8216.7	8470	8708.3
2465	2855	3202	4540	5700	6275	6975	7491.7	7740	7980	8220	8473.3	8710
2470	2860	3205	4580	5706.7	6300	7000	7500	7741.7	7983.3	8225	8475	8716.7
2475	2865	3210	4610	5725	6306.6	7006.6	7506.6	7750	7990	8233.3	8480	8720
2480	2870	3220	4620	5730	6315	7025	7508.3	7758.3	7991.7	8240	8483.3	8725
2485	2875	3225	4635	5740	6325	7040	7510	7760	8000	8241.7	8490	8730
2490	2880	3230	4680	5750	6335	7050	7516.7	7766.7	8006.6	8250	8491.7	8733.3
2495	2885	3235	5782.5	5760	6340	7073.3	7520	7770	8010	8258.3	8500	8740
2505	2890	3240	5800	5773.3	6350	7075	7525	7773.3	8016.7	8260	8506.6	8741.7
2510	2895	3290	5806.7	5775	6362	7100	7530	7775	8020	8266.7	8508.3	8750
2515	2905	3310	5820	5780	6373.3	7106.6						

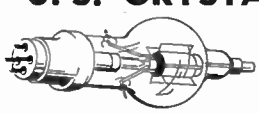
ZENITH MODEL DC-18-A 1,000 KC CRYSTAL

Built-in 12 V. automatic thermostatic controlled heating unit. 8-pin octal base. Ea. (Shipping wt. ½ lb.) **$5.95**

TERMS: All items subject to prior sale and change of price without notice. Minimum crystal order: $2.50. ALL crystal orders MUST be accompanied by check, cash or M.O. WITH PAYMENT IN FULL. NO C.O.D. IN ORDERING INDIVIDUAL CRYSTALS, INCLUDE APPROX. 5c PER CRYSTAL FOR POSTAGE. Also indicate second choice frequencies wherever substitution may be made. Calif. buyers add sales tax.

U. S. CRYSTALS JUNE MISCELLANEOUS SPECIALS

RK-65 IDEAL FOR SINGLE SIDE BAND



500 WATTS RAYTHEON TETRODE TUBE

Guaranteed! Brand New!

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SENSATIONAL PACKAGE OFFER OF 3 RECEIVERS COMPLETE WITH TUBES & DYNAMOTORS!

75 MC RECEIVER Used, clean. Ship. wt. 14 lbs. Ea. $4.95

COMMAND RECEIVER 6-9 MC. With tubes, used, good cond. Wt. 10 lbs. Ea. $4.95

ARC-5 RECEIVER 3-6 MC. Less dial plate. Ship. wt. 10 lbs. Used, clean. Ea.....$4.95

ALL THREE RECEIVERS (Wt 40 lbs.) ONLY **$9.95**

TUBES—NEW! GUARANTEED

Eimac 3STG Ea. $2.95 | 5CP1 $2.95 | ANY 2 TUBES VT-127A ..... 2.95 | 78P7 2.95 | **$5.00**

COMMAND EQUIPMENT

THE FAMOUS "Q-5er" 190-550 KC. With tubes. Used, good condition. Wt. 10 lbs..... **$10.95**

3-6 MC. With tubes. less dial. Used. good condition. Wt. 10 lbs.....$7.95

6-9 MC. With tubes. Used, good condition. A hot buy! Wt. 10 lbs.....$4.95

BC-456 MODULATOR. With tubes. good condition. Reduced! Wt. 20 lbs....$2.45

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Includes two 455KC IF TRANSFORMERS

Channel	Crystal Frequency (KC)	Channel	Crystal Frequency (KC)	Channel	Crystal Frequency (KC)	Channel	Crystal Frequency (KC)	Channel	Crystal Frequency (KC)	Channel	Crystal Frequency (KC)
38	440.741	42	448.148	46	455.556	50	462.963	54	470.370	58	477.778
39	442.593	43	450.000	47	457.407	51	464.815	55	472.222	59	479.630
40	444.444	44	451.852	48	459.259	52	466.667	56	474.074		
41	446.296	45	453.704	49	461.111	53	468.519	57	475.926		

Regular value: $18.38 Same day shipment. Satisfaction guaranteed.

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80 FT-241—LOW FREQUENCY CRYSTALS

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120 FT-243

4035	5205	6373.3	7373.3
4045	5235	6406.7	7406.7
4080	5305	6440	7440
4095	5327	6473.3	7473.3
4110	5335	6506.7	7506.7
4135	5397.5	6540	7540
4175	5437.5	6573.3	7573.3
4190	5485	6606.7	7606.7
4215	5500	6640	7640
4255	5587.5	6673.3	7673.3
4280	5706.7	6706.7	7706.7
4295	5740	6740	7740
4340	5773.3	6773.3	7773.3
4395	5806.7	6806.7	7806.7
4397.5	5840	6840	7840
4445	5873.3	6873.3	7873.3
4450	5906.7	6906.7	7906.7
4490	5940	6940	7940
4495	5973.3	6973.3	7973.3
4535	6006.7	7006.7	8006.7
4620	6040	7040	8040
4680	6073.3	7073.3	8073.3
4695	6106.7	7106.7	8106.7
4735	6140	7140	8140
4840	6173.3	7173.3	8173.3
4845	6206.7	7206.7	8206.7
4852	6240	7240	8240
4930	6273.3	7273.3	8273.3
4950	6306.7	7306.7	8306.7
5030	6340	7340	8340

Complete with crystal storage box

Regular value $87.75

Same day shipment. Satisfaction guaranteed.

$24.95

SPECIAL PACKAGE NO. 7 Ship. Wt. 9 lbs.

SPECIAL PACKAGE DEAL NO. 8

120 FT-243

Complete with crystal storage box

Regular value $87.75

Same day shipment. Satisfaction guaranteed.

$24.95

SPECIAL PACKAGE NO. 8—Ship. Wt. 9 Lbs.

5675	6425	7175	7925
5700	6450	7200	7950
5725	6475	7225	7975
5750	6500	7250	8000
5775	6525	7275	8025
5800	6550	7300	8050
5825	6575	7325	8075
5850	6600	7350	8100
5875	6625	7375	8125
5900	6650	7400	8150
5925	6675	7425	8175
5950	6700	7450	8200
5975	6725	7475	8225
6000	6750	7500	8250
6025	6775	7525	8275
6050	6800	7550	8300
6075	6825	7575	8325
6100	6850	7600	8350
6125	6875	7625	8375
6150	6900	7650	8400
6175	6925	7675	8425
6200	6950	7700	8450
6225	6975	7725	8475
6250	7000	7750	8500
6275	7025	7775	8525
6300	7050	7800	8550
6325	7075	7825	8575
6350	7100	7850	8600
6375	7125	7875	8625
6400	7150	7900	8650

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KIT $12.90 WIRED $14.90

VACUUM TUBE VOLTMETER #221
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R-C BRIDGE & R-C-L COMPARATOR #950B
KIT $19.95 WIRED $29.95

MULTI-SIGNAL TRACER #145
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6V & 12V BATTERY ELIMINATOR & CHARGER #1050
KIT $29.95 WIRED $38.95

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A TRANSISTORIZED LIGHT-BEAM AUDIO TRANSMITTER

"Aiming" of the transmitter and receiver is facilitated by mounting them on tripods equipped with pan-heads.

By
G. B. TIFFANY
and
NATHAN O. SOKAL

A completely transistorized version of a circuit originally described in May 1954 issue. CK721 "p-n-p" units are used.

A PREVIOUS article[1] described a light-beam audio communication system composed of a transistorized receiver and a transmitter which used vacuum tubes. The transmitter has since been transistorized, and the unit is now fully portable. The experimenter can set up communications anywhere he wishes, without need of a.c. power lines. Power consumption of the transmitter has been reduced to less than 7 watts, 60% of that of the original model, and the unit is now housed in a 6 x 2 x 3½-inch case, exclusive of batteries. Receiver sensitivity has been increased also, and reliable communication has been achieved over a distance of 800 feet.

Light-beam communication works as follows: A light source at the transmitter is made brighter or dimmer, corresponding to the instantaneous value (positive or negative) of the audio waveform to be transmitted. At the receiver, a phototransistor draws a current proportional to the amount of light reaching it from the transmitter. As the transmitter light source is made brighter and dimmer, the phototransistor current in the receiver increases and decreases. This current variation is amplified by the transistor amplifier and applied to a pair of earphones, making the signal audible.

The light from the transmitter is collimated into a narrow beam, giving good power efficiency for point-to-point communication. A narrow beam is desirable in order to send the maximum amount of energy to the receiver, instead of radiating it in other directions, where it is not needed. The narrow beam also ensures secrecy of communication, since only those in the direct path of the beam can detect the transmission.

The light source used in the transmitter was a *Sylvania* R1131C glow modulator tube. This is a gas-filled tube whose glow is concentrated in a small area, about 0.09 inch in diameter. The light output is proportional to the current through the tube; varying the tube current modulates the light output. The small area of the glow makes this an ideal light source for beamed transmission, since a small source of light is required to generate a narrow beam.

The tube is rated for a maximum peak current of 55 ma., and an average current of 3 to 25 ma. Maximum output and modulation are achieved by setting the average current at 25 ma. and changing the current ± 25 ma. from the average value.

The a.c. plate resistance of an average tube is about 300 ohms at 500 cps, which is about the frequency where maximum audio energy occurs. A current change of ± 25 ma. in a resistance of 300 ohms represents a power of about 100 milliwatts, assuming a sine-wave signal. This is the power required to modulate the glow tube output in the shunt-fed circuit of Fig. 1. (The tube the authors used had a plate resistance of about 900 ohms and required about 300 milliwatts.) The signal source applies an a.c. voltage to the glow tube, causing an a.c. current to flow in the tube. The inductive "B+" feed offers high impedance to the a.c. signal, and little a.c. current is diverted to the "B+" supply.

The easiest way to get the required 100 (or 300) milliwatts for modulation of the glow tube is from a push-pull class B amplifier, as shown in Fig. 2, since a single-ended class A amplifier cannot deliver so much power with-

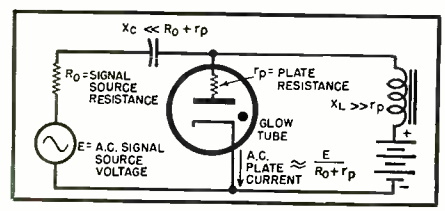
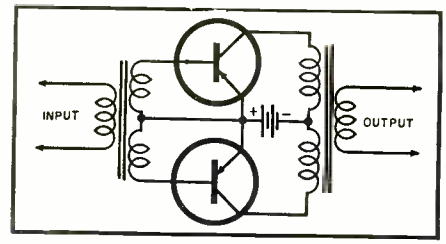
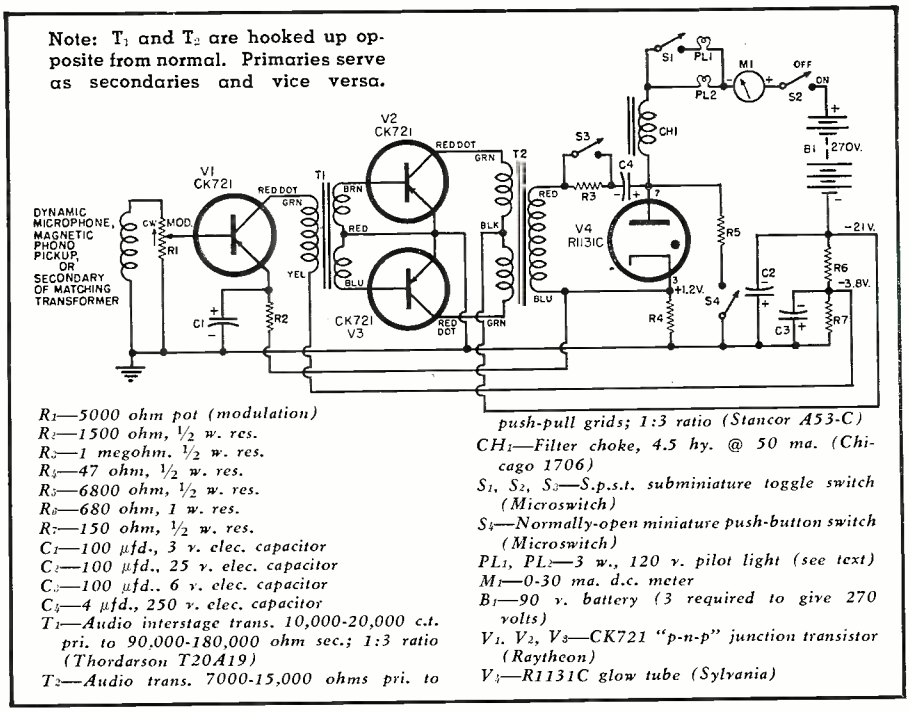


Fig. 1. Modulation of the glow tube output.

Fig. 2. Push-pull class B amplifier which serves as "signal source" of tube, Fig. 1.





R1—5000 ohm pot (modulation)
R2—1500 ohm, ½ w. res.
R3—1 megohm. ½ w. res.
R4—47 ohm, ½ w. res.
R5—6800 ohm, ½ w. res.
R6—680 ohm, 1 w. res.
R7—150 ohm, ½ w. res.
C1—100 μfd., 3 v. elec. capacitor
C2—100 μfd., 25 v. elec. capacitor
C3—100 μfd.. 6 v. elec. capacitor
C4—4 μfd., 250 v. elec. capacitor
T1—Audio interstage trans. 10,000-20,000 c.t. pri. to 90,000-180,000 ohm sec.; 1:3 ratio (Thordarson T20A19)
T2—Audio trans. 7000-15,000 ohms pri. to push-pull grids; 1:3 ratio (Stancor A53-C)
CH1—Filter choke, 4.5 hy. @ 50 ma. (Chicago 1706)
S1, S2, S3—S.p.s.t. subminiature toggle switch (Microswitch)
S4—Normally-open miniature push-button switch (Microswitch)
PL1, PL2—3 w., 120 v. pilot light (see text)
M1—0-30 ma. d.c. meter
B1—90 v. battery (3 required to give 270 volts)
V1, V2, V3—CK721 "p-n-p" junction transistor (Raytheon)
V4—R1131C glow tube (Sylvania)

Fig. 3. Complete schematic diagram of the transistorized version of the transmitter.

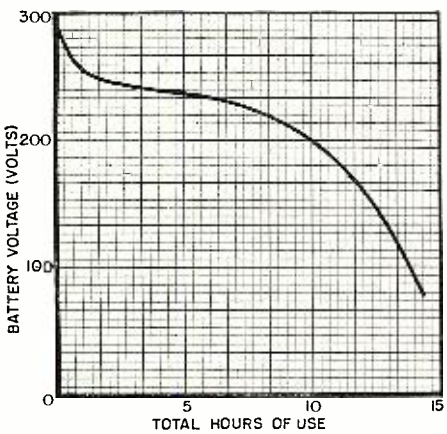
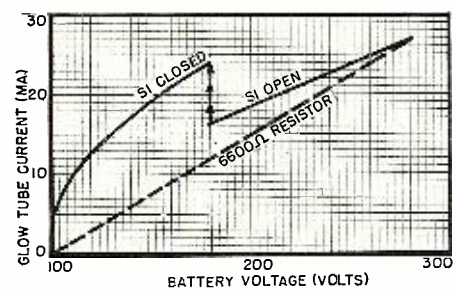


Fig. 4. Battery voltage vs hours in use, based on operation of two hours a day.

out exceeding the manufacturer's ratings on collector dissipation and/or collector voltage and/or collector current. Power transistors capable of delivering this amount of power in class A single-ended operation are still too expensive for the average experimenter.

Operation of the class B transistor amplifier[2] is quite similar to that of a class B vacuum-tube amplifier. A full description can be found in any of the standard texts [3, 4]. Briefly, both transistors are normally biased to cutoff. As can be seen in Fig. 2, both bases and emitters are returned to ground, so that the collector currents are almost zero. A signal on the primary of the input transformer drives one base positive and the other base negative, because of the push-pull connection of the secondary. The positive base cuts off its transistor, while the transistor with the negative base is turned on. When the signal polarity reverses, the transistor which was conducting is cut off, and *vice-versa*. Thus the two transistors work alternately for positive and negative swings of the input signal on the primary of the input transformer. The main difference between the transistor and the vacuum-tube class B amplifiers is that the transistor presents a low impedance to the input transformer as soon as the base is made negative, while a vacuum-tube grid remains high-impedance until zero-bias is reached. Thus the loadings on the input transformer are considerably different for vacuum-tube and transistor amplifiers.

Fig. 5. Glow-tube current vs battery voltage for the transmitter circuit. Fig. 3.



The class B stage can be driven by an ordinary single-ended class A stage whose output transformer secondary is center-tapped. The class A amplifier, in turn, can be driven from the source of audio signal, such as a microphone or phonograph. Highest gain is obtained if the source impedance is matched to the transistor input impedance. 500-ohm microphones or 100-millihenry magnetic phonograph pickups fill the bill fairly well; other sources should be brought to an impedance level of about 1000 ohms by the use of matching transformers.

The complete schematic diagram for the transmitter is shown in Fig. 3, incorporating all the circuits discussed before, plus a few more to be described in the following paragraphs.

Power Source

Batteries are the most convenient source of power for portable equipment and are used in this design. In a total space of about 3¾ x 3¾ x 4 inches, three 90-volt "B" batteries supply 270 volts to operate all circuits. Battery life is determined partly by how well the equipment will operate with partially-discharged batteries. A typical curve of battery voltage *vs* hours of use is shown in Fig. 4. Obviously the useful battery life will be longer if lower output voltage can be tolerated. A conservative value of battery end-of-life is 65% of nominal voltage; thus good battery life can be obtained if the circuits will work properly when the 270-volt power supply has decayed to 176 volts. The circuit features to be described make possible operation down to about 130 volts, and expected battery life is 13 total hours of operation, when used for two hours per day[5]. Larger batteries will last longer, of course.

The voltage across the glow tube is less than 150 volts at any current within the operating range of 3 to 55 ma. In order to make current flow in the tube, the battery voltage must then be equal to or greater than 150 volts. 65% of nominal battery voltage will be 176 volts, and there will still be sufficient voltage to operate the tube at the end of battery life. However, the wide variation in battery voltage during life (see Fig. 4) would cause excessive variations in tube current. This trouble is avoided by providing the two 3-watt, 120-volt lamps between the battery and the shunt-feed choke, shown in Fig. 3. The lamps have a regulating action, tending to keep the current constant. This is shown in Fig. 5, a graph of tube current *vs* battery voltage for the circuit of Fig. 3; the dashed line shows for comparison what the current would be with a 6600-ohm fixed resistor instead of the lamps. When the current decays to about 15 ma., switch S_1 can be closed, taking us to the upper curve of Fig. 5, and back to 25 ma. tube current. When the current then reaches about 12 ma., the batteries can be replaced and S_1 opened. If more precise current control is desired, a 7500-ohm, 4-watt rheostat can be substituted for the lamps and S_1.

A minimum of 225 volts should be provided to light the glow tube when the power is turned on. Obviously the battery cannot do this when its voltage has fallen below 225 volts, part-way through life. S_1, a normally-open push-button switch, can be momentarily pushed and released to light the glow tube if the battery voltage is not adequate. Closing S_1 causes d.c. current to flow in the shunt-feed choke. When S_1 is opened, the inductive "kick-back" of the coil generates enough voltage to light the tube. The tube conducts at a lower voltage than is required for arcing across the switch

contacts, so the switch is in no danger. An inductance of ½ henry or more at 25 ma. is satisfactory. S_3 should be open when the unit is being turned on, to prevent the initial surge on the glow tube from being coupled to the class B transistors, thus avoiding possible breakdown of the collector junctions. S_3 may be closed after the glow tube lights.

Optical System

The light glow of the glow modulator tube is placed at the focus of a condensing lens to project the light in a narrow beam. The authors used a double-convex lens of about 1¾ inches diameter and 1¾ inches focal length; the measured beamwidth was 5 degrees. The receiver used a 6½-inch condensing lens to collect light from the transmitter beam. The sensitive spot of the receiver phototransistor should be placed at the focus of the receiver lens. Try moving the phototransistor forward and back to find the position of best focus, and move the light spot side-to-side, and up and down on the sensitive surface to locate the point of maximum response. The circuit used in the receiver is shown in Fig. 6; it is an improved version of one described in a previous article.[1]

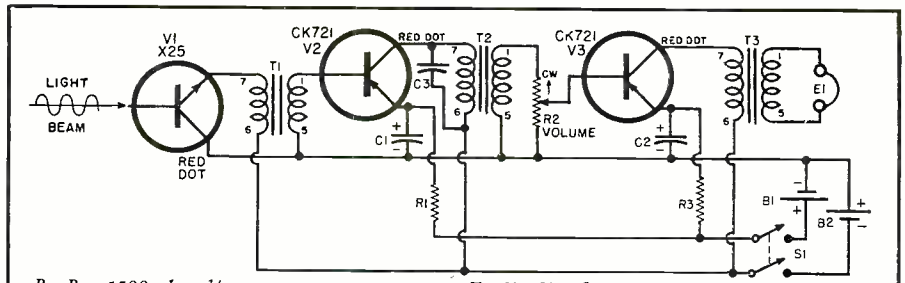
Those who read the article in the May issue will immediately recognize this new circuit as a more elaborate version of the earlier unit. Another stage has been added which requires the inclusion of another plate-to-line transformer and the addition of another transistor. While these refinements increase the cost of the completed unit somewhat, the improved performance offered by this unit outweighs the expense.

The receiver itself is no more difficult to build than the original unit although it may be necessary to obtain a slightly larger housing for the receiver to accommodate the added stage and its associated transformer. The best procedure to follow would be to obtain your transformers first and then determine the maximum over-all chassis space that will be occupied by the transformers and the few additional parts that will be required. In any event, the completed unit will be compact since the use of transistors permits "crowding" of parts as there is no heat-dissipation problem.

Aiming the transmitter and the receiver is made much easier by mounting them on photographic tripods equipped with pan-heads. This is easily done by bolting, onto the base of each unit, a ¼" plate with a ¼"-20 tapped hole to receive the tripod screw.

Components

Inexpensive condensing lenses can be obtained from *Edmund Scientific Corp.*, Barrington, N. J. or *A. Jaegers*, Lynbrook, N. Y. *Raytheon* CK721 transistors were used by the authors, although any other *p-n-p* units should be satisfactory, such as *Sylvania*, *Radio Receptor*, or *RCA* 2N34's, or *Raytheon* CK722's. The *n-p-n* transistors can be



R_1, R_3—1500 ohm, ½ w. res.
R_2—5000 ohm pot ("Volume")
C_1, C_2—50 μfd., 3 v. elec. capacitor
C_3—.004 μfd. paper or ceramic capacitor
S_1—D.p.s.t. switch
B_1, B_2—1.5 volt battery
E_1—500-1000 ohm magnetic headphones
T_1, T_2, T_3—Single plate-to-line trans., 15,000 ohms to 50,200/250,500/600 ohms (UTC O-8 or O-9)
V_1—X-25 phototransistor (Transistor Products, Inc. See text)
V_2, V_3—CK721 "p-n-p" junction transistor (Raytheon)

Fig. 6. An improved version of the transistor receiver described in the May, 1954 issue.

used if the battery polarity is reversed from that shown in Fig. 3; this will also require changing the polarities of the electrolytic bypass capacitors, the glow tube, and the meter. Transformer turns ratios are shown on the schematic diagram of Fig. 3. The authors used *Stancor* A53-C and *Thordarson* T20A19 units although other similar transformers should prove satisfactory, and lower-impedance transformers would be even better. The glow modulator tube was a *Sylvania* R1131C. Subminiature *Microswitch* units were used for S_1, S_2, S_3, and S_4, and the 1-inch panel meter was made by *International Instruments*, New Haven, Conn. (Standard-size components would work equally well, of course.) Three *Eveready* 490 or *Burgess* N60 batteries in series provide the 270-volt power supply.

Phototransistors for the receiver are now available from *Texas Instruments, Inc.*, Dallas 9, Texas (Type 800), *Scientific Specialties Corp.*, Boston 35, Mass. (Sensiton phototransistor type SS7), and *Radio Receptor Co., Inc.*, New York 11, N. Y. (Type RR66), as well as the original supplier, *Transistor Products, Inc.*, Waltham 54, Mass. (Type X-25). Emitter and collector connections of the RR66 should be interchanged from those shown in Fig. 6, since this is a "*p-n-p*" transistor. The base lead may be left unconnected.

The authors wish to thank Messrs. F. Campbell (W1ABV) and M. Woronoff for their expert mechanical assistance.

A commercial version of this device will be manufactured by *The Photocontrols Co.*, 258 East Street, Lexington 73, Mass. Kits are available for the experimenter to assemble.

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4. *Arguimbau, L. B.: "Vacuum-Tube Circuits," John Wiley and Sons, Inc., N. Y., 1948, Chapter 6.*
5. *Calculated from data in "Battery Engineering Data," National Carbon Co., N. Y.*

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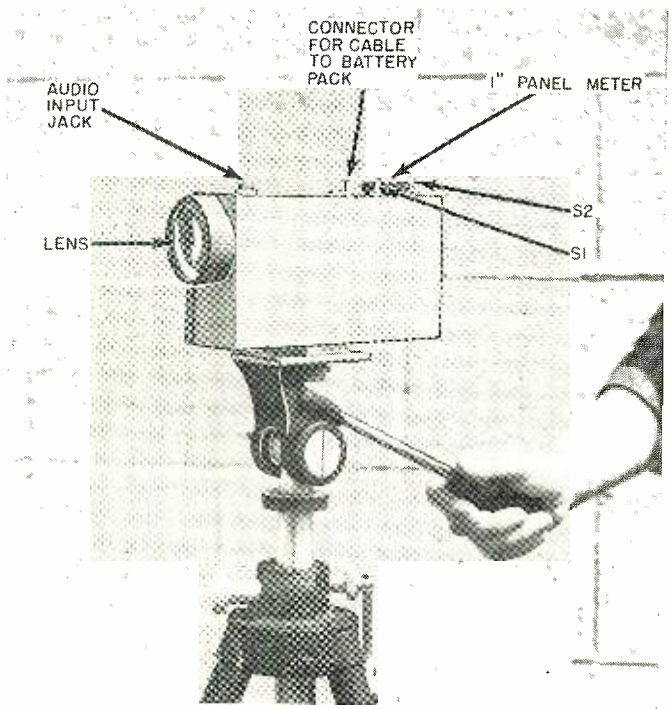


Close-up view of the unit mounted on tripod with all of the external components identified. Note the panel meter mounted so that it is readable from the top by person operating the light-beam equipment.

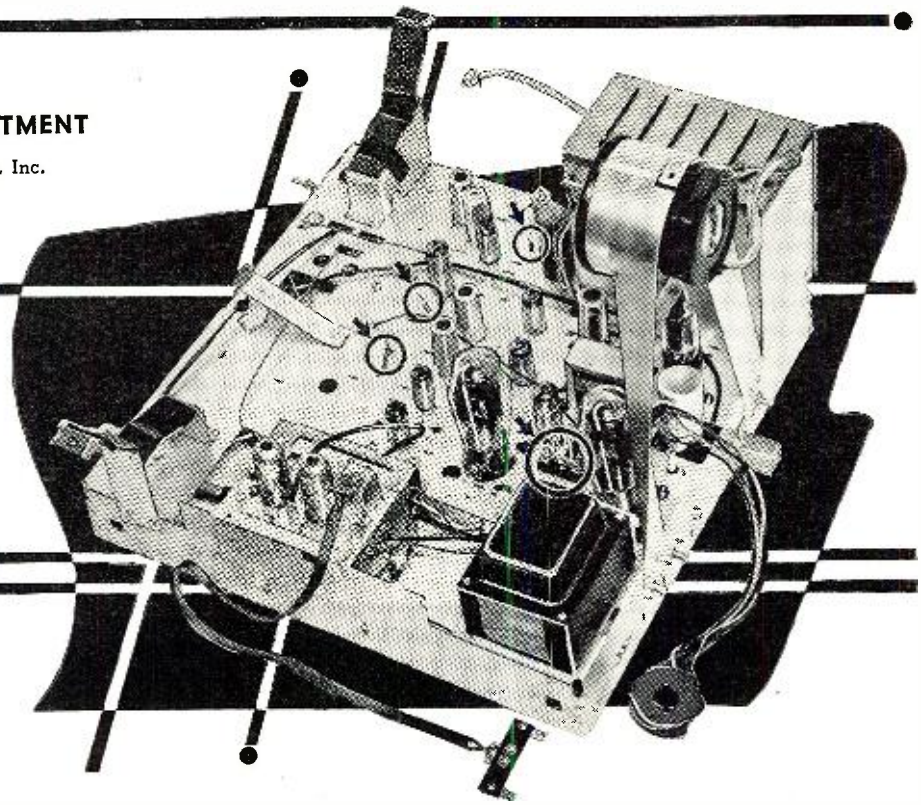
TEST POINTS ON 955 DU MONT TV SETS

By

TELESET SERVICE DEPARTMENT

Allen B. Du Mont Laboratories, Inc.

Tracking down a. g. c. and intermittent sync troubles can be speeded up by using the test points provided.



This is the 1955 Du Mont TV chassis whose test points are discussed here.

MUCH information regarding receiver performance can be obtained by making use of the test points provided on top of the chassis. As shown in Fig. 1, leads brought up through holes in the chassis serve as test points for the r.f. a.g.c., i.f. a.g.c., video detector output, and a.f.c. circuit. Properly used, these points can be of great value in locating and correcting trouble.

Video Detector Output

Fig. 2A illustrates the waveform that should normally be observed on an oscillograph connected to the video detector output test point. Observation at this point is important for several types of receiver troubles.

One troublemaker that can easily be detected by observing the waveform at this point is hum modulation in the r.f. or i.f. circuits. Usually, hum modulation can be recognized by the characteristic wide, dark bars that extend horizontally across the picture. One dark bar covering approximately half of the picture appears if the hum is at 60 cycles, and two dark bars separated by a light area are seen if the hum is at 120 cycles.

Sometimes, however, the hum is not severe enough to cause noticeable hum bars on the picture. In such cases, the defect is usually evidenced by vertical rolling that occurs intermittently. The service technician is logically led to believe that the trouble in such cases is in the vertical sync circuits, and much time can be lost in looking there for the trouble. This time can be saved by checking the video detector output waveform before troubleshooting the sync circuits. Even a relatively slight amount of hum modulation on the signal shows up as a waveform that is "S"-shaped, rather than straight, along the horizontal axis. The effect is shown accentuated in Fig. 2B. Much less distortion than this can cause poor vertical hold.

The reason that the vertical roll is intermittent is because the peaks and troughs of the hum are made to move along the video i.f. waveform by the difference in phase between the power line and the transmitted signal. When the phasing is such that the vertical sync pulse amplitude is less than the other portions of the signal, as in Fig. 2B, the receiver loses vertical sync. Under the opposite condition of phasing, the receiver locks into synchronization. A tube with heater-to-cathode leakage, located in the r.f. or i.f. circuits, can cause 60-cycle hum modulation. A defective filter capacitor can result in 120-cycle modulation.

Other defects in the circuits preceding the video amplifier can also be detected by observing the video detector output waveform. For example, the waveforms of Figs. 2C and 2D show two different types of a.g.c. trouble. Sync compression is indicated by Fig. 2C. With this condition, the picture appears excessively dark, and if the compression is severe enough, the picture will lose sync. An improperly adjusted "Dumonitor" control (see Fig. 3) or a partial short across the i.f. a.g.c. line can cause this effect.

White compression is indicated by the waveform of Fig. 2D. The picture under this condition will have a "washed out" appearance and a deficiency in contrast. An improperly adjusted a.g.c. delay control or a short across the r.f. a.g.c. line can cause this effect during reception of a strong signal.

Further information regarding the effects illustrated in Figs. 2C and 2D can be obtained by making use of the r.f. and i.f. a.g.c. test points.

R.F. and I.F. Test Points

These test points are located physically as shown in Fig. 1 and electrically as shown in Fig. 3. Under the conditions illustrated in Figs. 2C and 2D, improper voltages will appear at the a.g.c. test points, serving as verification that trouble exists in the a.g.c. circuits. The a.g.c. voltages that should be obtained with a wide range of signal inputs to the receiver are plotted in Fig. 4.

As indicated in the partial schematic of Fig. 3, the "Dumonitor" control affects both the i.f. and r.f. a.g.c. when the "L-D" (local-distant) switch is in the "D" position. Accordingly, the curves of Fig. 4 are plotted with the "L-D" switch set in the "L" position to eliminate the effect of the "Dumonitor" control setting. Two sets of curves are shown. The dashed curves apply when the a.g.c. delay control is rotated completely clockwise (maximum delay), and the solid curves apply when the control is rotated completely counterclockwise (minimum delay).

It should be noted that neither of the control settings used in plotting Fig. 4 provides optimum a.g.c. condi-

tions. With the dashed curves, conditions are good for weak signal reception, but overload is encountered at relatively low signal input levels as indicated by the short curve. In contrast, the solid curves indicate conditions that are good for reception of strong signals but result in a poor signal-to-noise ratio for weak signals. A very wide range of signal inputs can be accommodated with the a.g.c. delay control set so that the a.g.c. curves fall between those shown on Fig. 4. The curves are drawn with the control at both extremes of rotation so that the conditions can be duplicated for troubleshooting purposes.

By measuring a.g.c. voltages under varying conditions of signal input and comparing the readings against Fig. 4, it can be determined whether or not the a.g.c. circuits are functioning properly. A v.t.v.m. should always be used in measuring a.g.c. voltages.

The a.f.c. test point is used in adjusting the horizontal oscillator. Such adjustment is sometimes required as a result of aging or replacement of tubes and components.

To adjust the horizontal oscillator:

1. Set the horizontal hold control (located on the front panel) to the center of its mechanical range.
2. Short the a.f.c. test point to ground.
3. Adjust the horizontal stabilizer control (on rear of chassis) to the position where the picture holds sync momentarily. (Note: With the a.f.c. test point shorted, the a.f.c. circuits are not functioning and the receiver will not hold sync continuously.)
4. Remove the short from the a.f.c. test point.

The ⅜ ampere fuse mounted on the top of the chassis serves as a convenient point to check the "B+" voltage. Under normal operating conditions, with a line voltage of 117 volts a.c., "B+" at the fuse should be approximately 235 volts.

Since this fuse is in the line that supplies power to the horizontal output stage, a burned-out fuse can indicate trouble in the horizontal output, damper, or high voltage circuits. A short or partial short across the "B+" boost line can also cause the fuse to burn out.

The test points discussed in this article are found in the RA-312 and RA-313 *Du Mont* TV chassis. Some modification in the location of these test points may occur in later production runs of these chassis. However, such modifications will probably be minor ones.

Editor's Note: The July issue and succeeding issues of RADIO & TELEVISION NEWS will carry articles on the test points built into the 1955 television chassis of other popular makes. Since a "speaking acquaintance" with these test points and their function can save the technician valuable servicing time, we recommend that you follow this series closely. Next month the new *Emerson* television chassis will be discussed. —30—

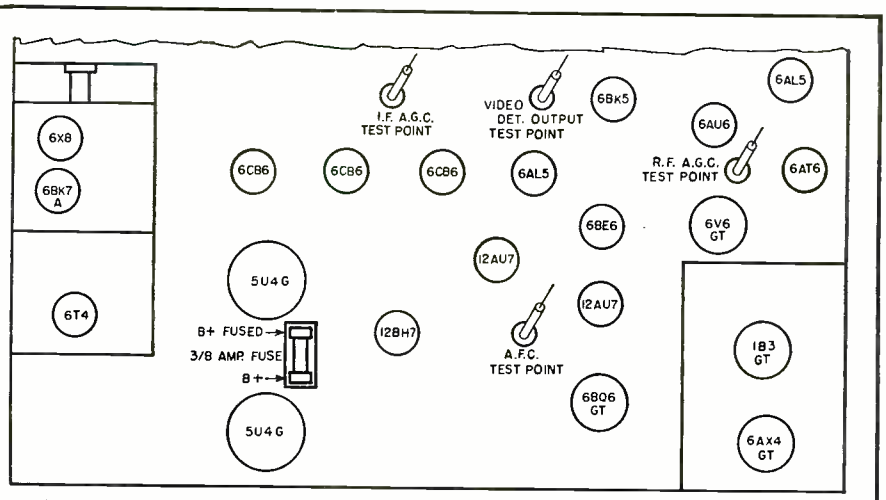


Fig. 1. Above chassis layout of the Du Mont RA-312 and RA-313 TV receivers.

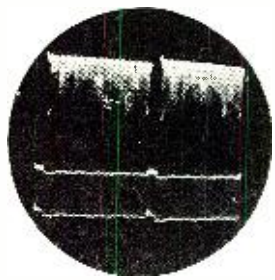


Fig. 2A. Normal video detector output wave.

Fig. 2B. Hum modulation before detector.

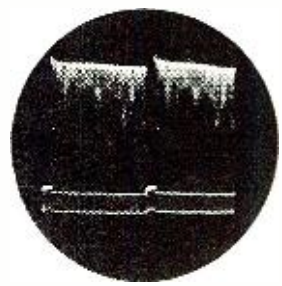


Fig. 2C. Sync compression due to poor a.g.c.

Fig. 2D. White compression due to a.g.c. fault.

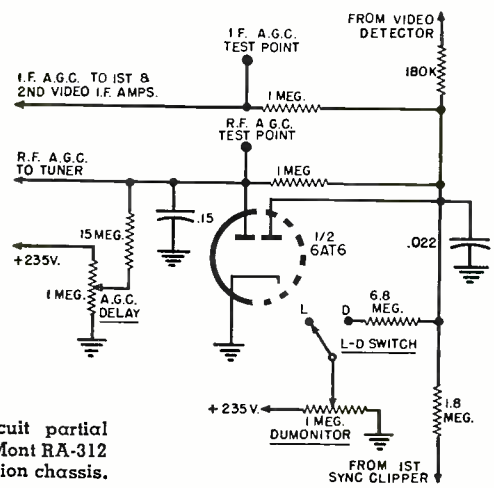
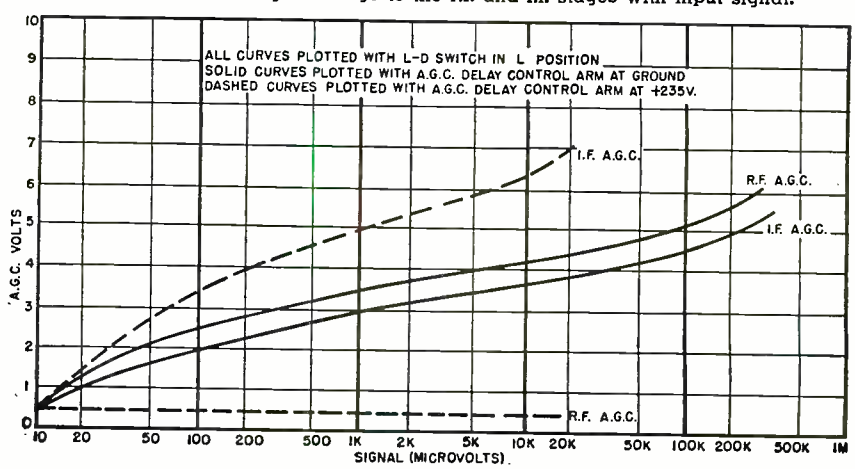
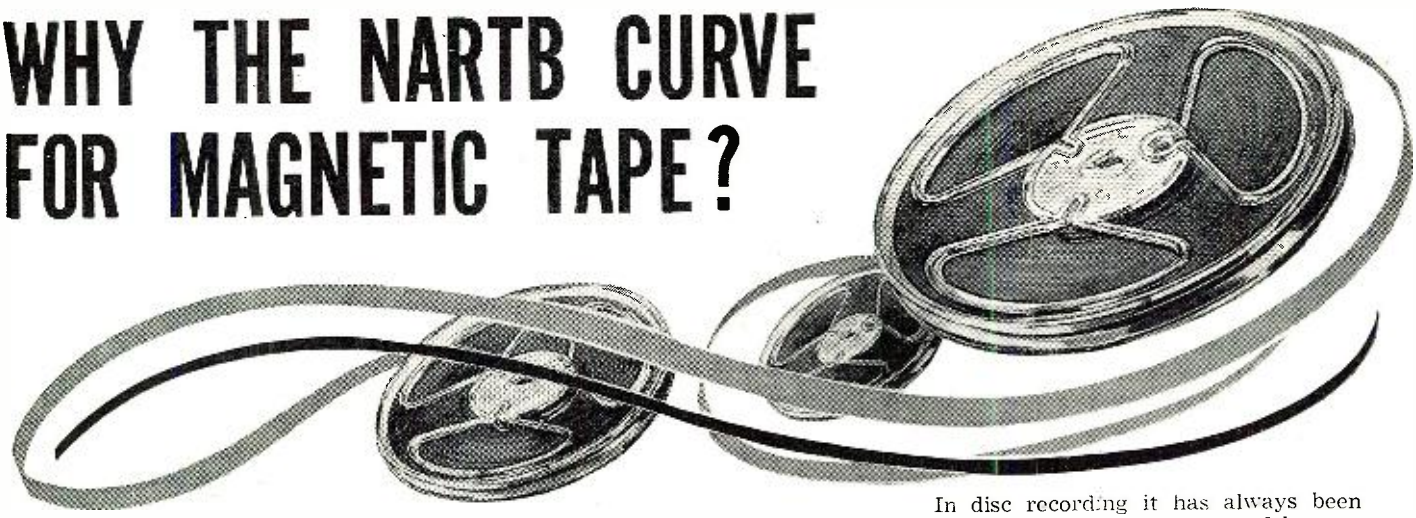


Fig. 3. A.g.c. circuit partial schematic for Du Mont RA-312 and RA-313 television chassis.

Fig. 4. Variation of a.g.c. voltage to the r.f. and i.f. stages with input signal.



WHY THE NARTB CURVE FOR MAGNETIC TAPE?



By **W. E. STEWART**
Director of Engineering, The Maico Co., Inc.

The standard, as set by the NARTB, applies solely to 15 ips recordings. Although standards for other speeds have not as yet been approved, same principles can be applied to them.

IN OUR daily work with tape recorders it is often easy to forget some of the fundamentals. For instance, in order to obtain the frequency characteristics of a particular head and tape combination we may run a curve by putting a constant audio current into the head and then playing back the resulting signal on the tape. We then say that we will equalize for this characteristic by placing half the compensation in the recording amplifier and half in the playback amplifier. This is especially handy when the same amplifier serves for both recording and playback, as is often the case. However, we have greatly over-simplified the situation by doing so. What happens when the tape is put on another machine with different characteristics? The answer is often disconcerting. Are we using the tape to its best advantage? We usually don't know. It was in an attempt to derive some reasonable answers to these questions that the NARTB Subcommittee did its work and came up with the standard now in use.

The recording and reproduction of audio material involves the balancing of three basic qualities. These are: frequency response, distortion, and signal-to-noise ratio. Thus, if lower distortion is desired it usually means recording at a lower level, thus sacrificing signal-to-noise ratio. We can reduce the noise level further if we restrict the frequency range, etc. In well designed systems, either disc or magnetic tape, the recording medium is used to its maximum utility and becomes a limiting factor.

EDITOR'S NOTE: *Although in many instances the NARTB standards refer to a specific playback curve, basically the standard is confined solely to the characteristics of the information that is recorded on a tape. The standard applies solely to the tape. The idea, of course, is to standardize all tapes so that they can be used on any machine. Actually, in view of the variation between recording heads, one will find that the recording and playback sections of tape recorders will vary between manufacturers. Even though there is such variation, all still follow the NARTB standard in that the characteristic of the recorded material on the tape is the same—irrespective of the machine used.*

To use a recording medium to best advantage, it is important to know its behavior during the recording process.

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* The author was a member of the NARTB Subcommittee on Magnetic Recording Standards from May 1948 to June 1953; the last year as chairman. It was through this period that the present NARTB magnetic recording standards were formulated and accepted by the industry. During this time Mr. Stewart was manager of Broadcast Audio Engineering at RCA Victor Division, and was actively engaged in the design of professional disc and tape recording equipment.

Fig. 1. Graph of recording losses.

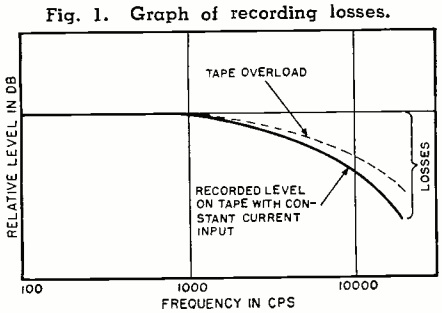
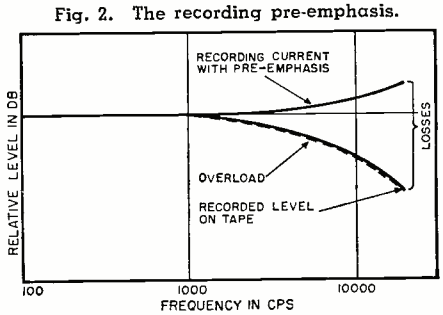


Fig. 2. The recording pre-emphasis.



In disc recording it has always been possible to examine the record by eye, usually aided with a low-power, calibrated microscope, and determine the limiting conditions. Maximum lateral excursion, over-cutting, relative amplitude at different frequencies, etc., can be easily observed. In magnetic recording, such visual checks have been impossible and other measuring methods have not been developed to the point where they are well understood or easy to apply. However, methods are available and it is hoped that they will become better understood and more widely used.

The NARTB equalization curve was developed with the philosophy that the record on the medium (that is, the recorded tape) is the most important point to standardize, since it is the item that is transferred from one machine to another.

Starting with this premise and ignoring the measuring problems for the moment, let us see what can be put on the tape to obtain the highest possible signal-to-noise ratio across the whole audio band without excessive distortion. If we take a typical magnetic tape and run a series of distortion curves on it we will find that it overloads at somewhat lower levels as the audio frequency increases. In other words, the overload characteristic of the tape droops at the higher frequencies. This statement is admittedly rather general, but it is close enough to the facts to serve as a starting point.

It will be noted that this is expressed in terms of the *record on the tape*. The recording process has several losses that are not constant with respect to frequency, so we cannot say that constant current recording gives a flat signal on the tape. Fig. 1 gives typical conditions during recording.

These losses include eddy current, stray capacity, resonance, etc., in the head and circuit as well as those due to the so-called demagnetizing effect of the ultrasonic bias currents used in most audio recording. These losses vary with the amount of bias, frequency of bias, type of tape, tape speed, etc. Thus, if a constant current is fed into the head, the recorded level on the tape is far from flat.

This condition obviously does not use the magnetic tape to its fullest extent at the higher frequencies. In order to record a signal at full level on the tape, regardless of frequency, it is necessary to "pre-emphasize."

Fig. 2 shows the results if we pre-emphasize just enough to bring the maximum recording level to the overload point at all frequencies.

However, another factor is involved. The recordist learned long ago that it is not necessary to assume that all audio material reaches the same amplitudes at all frequencies. Studies have shown that the maximum energy content of speech and music at different frequencies reaches the approximate relative values shown in Fig. 3[1, 2].

There are a few notable exceptions to this curve. For instance, pipe organs and some other instruments have very strong low-frequency energy and applause has strong high-frequency energy content. The skilled recordist will take these into account by backing down the recording level. Ignoring the special cases, it appears from Fig. 3 that we are not recording at the full level available on the tape if we simply pre-emphasize for the recording losses. It appears that at 10,000 cycles the loudest sounds will be recorded somewhat below the capability of the tape; and that at 50 cycles there is also a margin. In the fight to keep the signal high above the noise level the recordist would like to use the tape to its fullest capability. Hence, he uses still more pre-emphasis. At the high frequencies he "tips it up" as much as he feels he can without overloading the tape. At the low end he would like to leave it alone (for organ music, etc.), but he is plagued with 60-cycle hum pickup in the playback, so he tips up the low frequencies to override the hum a little more.

The result is a recording current curve somewhat like Fig. 4.

If a 1000 cycle signal were to be put into such a recording amplifier and adjusted to maximum recording level; and then the same level signal at 10,000 cycles put into the circuit, it is obvious that the tape would be overloaded, due to the pre-emphasis incorporated in the amplifier. For this reason frequency response measurements must be made at levels well below the maximum recording level. However, when voice or music are put into the recording amplifier and adjusted so the peaks are just reaching the overload point, the recordist knows that he can normally expect these peaks to be tones in the middle frequency range of 500 to 3000 cycles, and that any extremely high- or low-frequency peaks will be well below this.

The foregoing explains what is generally considered good recording practice. However, there were several reasons why it did not seem feasible to establish a recording standard in terms of the recording pre-emphasis curve. One of the simplest is the fact that the only way to check such a curve is by playing the recorded material back through a calibrated playback head. Since a calibrated playback head must be used anyhow, why not establish the standard in playback terms? This is what the NARTB recording standard has done.

To understand the problem of calibrating a playback head it is necessary to review the behavior of such a device. If we make a large head with a smoothly rounded face in close contact with the tape, laminated core structure, good coupling between core and coils, and an infinitesimally short gap, we will obtain a straight line relation between the head output and frequency. If the signal on the tape is at the same level at all frequencies, the output of the head will be a straight line rising 6 db per octave (20 db per decade) as shown in Fig. 5.

However, no head is ideal and there will be some loss due to eddy currents, winding capacity, etc., which we call frequency losses because they are a function of frequency. There is another group of losses called wavelength losses. At the high frequency end these are mostly caused by the fact that the gap must have finite length. These change their frequency relationship when the tape speed is changed and this gives us a method for measuring them. There can also be wavelength effects at the low frequencies, but if the head is large, and the tape is in good contact with the face for a sufficient distance on either side of the gap, these effects can be made negligible. The construction and calibration of such a head takes considerable skill and the laboratory procedure must be gone through enough times for the experimenter to be familiar with the various pitfalls, such as azimuth misalignment, overloaded tape, hum interference, etc.

Nevertheless, the NARTB committee eventually found that several laboratories could obtain the same results, and at least one method outlined in the final standard appeared to be entirely practical.

Note that the curve of Fig. 5 is not the usual playback curve taken with constant recording current, but one taken with constant level on the tape.

It is recommended in the standards that a head with a short gap be used

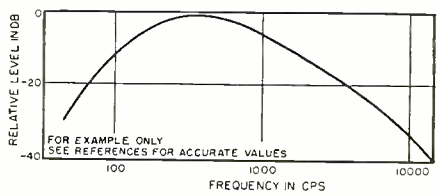


Fig. 3. Relative volume range at the different frequencies for speech and sound.

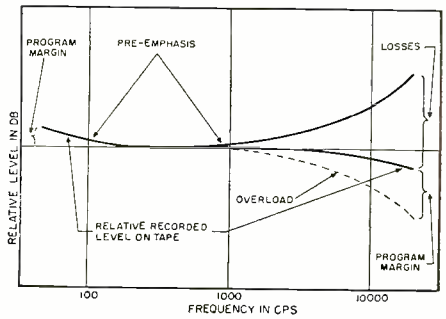


Fig. 4. Recording pre-emphasis. See text.

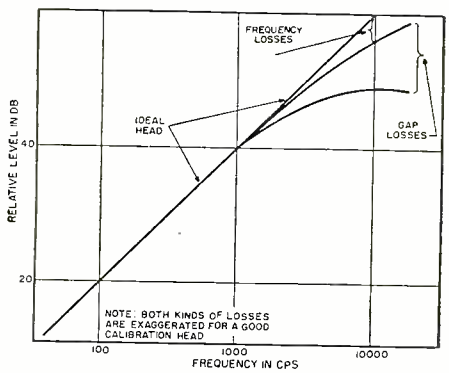


Fig. 5. Playback response (signal, flat).

that has not over 5 db "gap loss" at the highest frequency to be calibrated. Frequency losses are expected to be very low, but should be checked. A simple *RC* network can usually be used to compensate for the losses at the high frequencies so the response is corrected to a straight line with a 6 db per octave slope over the calibration range.

If a flat signal is then put on the tape and a compensation circuit is placed in the playback amplifier with a response which drops 6 db per octave as frequency increases, flat output re-

(*Continued on page* 112)

Fig. 6. Response of compensation circuit, NARTB standard reproducing characteristic.

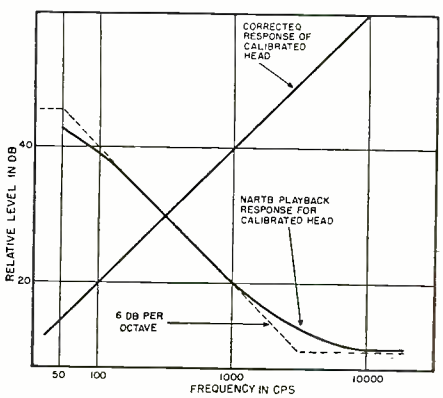
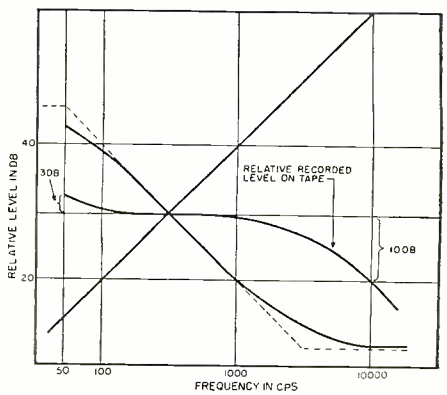
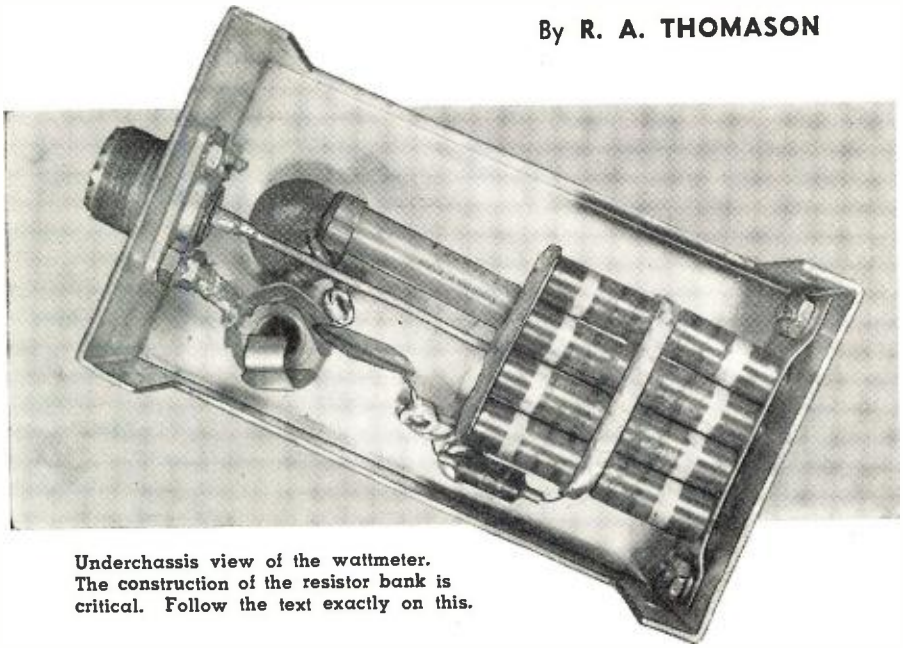


Fig. 7. NARTB standard recorded level on tape. All curves are for 15 ips speed.



INEXPENSIVE R. F. WATTMETER

By R. A. THOMASON



Underchassis view of the wattmeter. The construction of the resistor bank is critical. Follow the text exactly on this.

An inexpensive circuit to be used in conjunction with a standard v.o.m. for two-way communications service work.

SERVICING of two-way communications equipment is rapidly becoming an important source of income to many technicians. The quality of the service the customer demands on this type of equipment requires a sizable investment in special test instruments useful only for this type of work. The r.f. wattmeter described here will fill the need for one of these instruments at moderate cost. It is intended for use in the following cases:

1. In the shop where a limited amount of two-way service is done, and a more accurate instrument is not justified.

2. In the field where a minimum of test equipment is carried.

The unit is built into a *Bud* aluminum "Minibox," and is very compact (4" x 2¼" x 2¼").

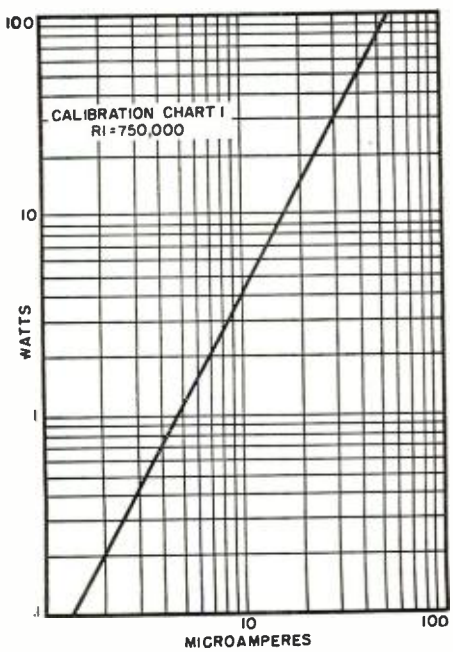
A *Simpson* 260 on the 100 microampere scale is used as an indicator of power. Other meters could be used here, of course; however, the calibration charts shown will not apply unless the instrument has the same sensitivity as the Model 260. The unit would be handier if it had its own meter built-in, calibrated directly in watts.

The parts layout can be seen from the photograph and is not critical except for the resistor bank R_2 through R_{17}. These resistors are 220-ohm, 2-watt carbon units. If it is not certain that the resistors selected are carbon, one should be broken. Wirewound resistors will not work here. In the resistor bank, the idea is to keep all leads short in order to avoid any inductive reactance. The bracket is made from four pieces of thin brass shim stock material. Each piece should be cut about two inches square with eight holes drilled in two columns, using a #68 drill. Centers are spaced the diameter of one resistor. Two banks of eight resistors are then made by threading the wires through the shim stock at each end. The wires are trimmed to about one-quarter inch and bent over. They are then soldered with a large hot iron, to avoid burning the resistors. The shim stock is trimmed down to the size of the bank, with the exception of one end which is left large enough for mounting the completed bank. At least four mounting bolts should be used here. The two banks are soldered together, being careful not to overheat the resistors.

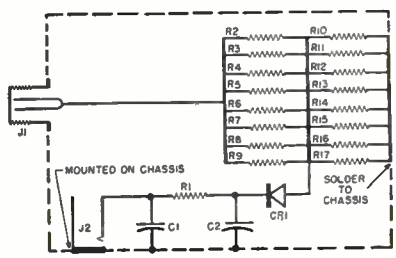
If it is desired to have the wattmeter cover both ranges as shown in Charts 1 and 2, a switch could be installed to change the value of R_1. A switch with low resistance contacts should be used.

Chart 1 is calibrated up to 100 watts; however, the unit should not be permitted to operate at the higher powers except for a few seconds at a time since the resistor bank is only rated at 32 watts.

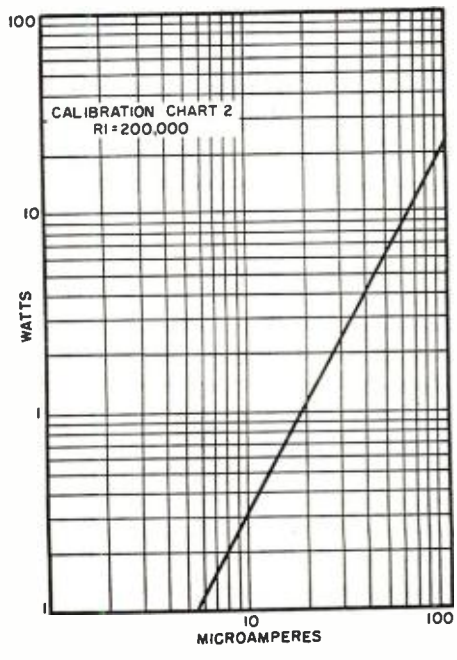
Several of these units were built and used with different Model 260 meters. The accuracy held within 10% over a frequency range of 4 to 170 megacycles. If a meter of known accuracy is available, it should be used to check the accuracy of the charts. —30—



Circuit diagram and parts list for the r.f. wattmeter. The resistors in the bank must be 2-watt carbon units.



R_1—750,000 ohm, ±1% (for Chart 1)
200,000 ohm, ±1% (for Chart 2)
R_2 through R_{17}—220 ohm, 2 w. carbon res.
C_1, C_2—.01 µfd. disc ceramic capacitor
CR_1—1N48 crystal diode
J_1—Coaxial chassis receptacle (Type VHF, N, BNC, etc.)
J_2—Phone jack



D.C. TELEVISION INSTALLATIONS

By
WALTER H. BUCHSBAUM
Television Consultant
RADIO & TELEVISION NEWS

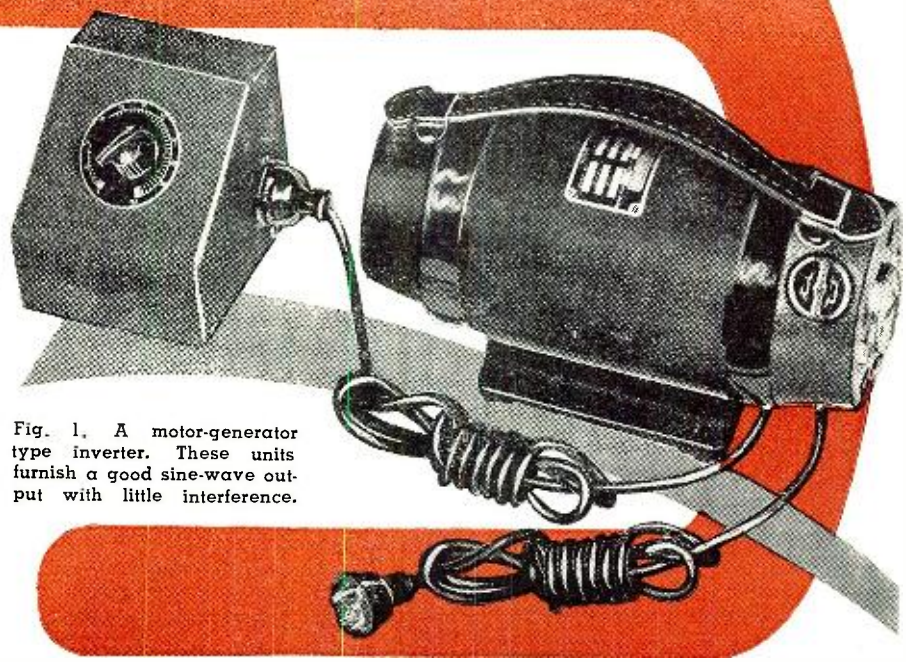


Fig. 1. A motor-generator type inverter. These units furnish a good sine-wave output with little interference.

Running an a.c. TV receiver off d.c. power lines or batteries is no problem if you know the proper type of inverter to use and what to do about interference.

MANY service technicians have never encountered the problem of d.c. installations, simply because their localities are wired for 117 volts a.c., which is the power used by all standard model TV receivers. In some of the older areas of electric power service, however, d.c. power is furnished and TV receivers as well as all other appliances must be suitable for d.c. operation. In addition to the areas using 117 volt d.c. lines, there are also many instances of battery power sources such as trucks, trailers, boats, wind-driven generators charging up storage batteries, and similar situations. Whether the installation takes place in a house trailer, an exhibition or showroom-type truck, or simply in a home with d.c. power lines, the methods and equipment used are the same.

There are some TV receivers which are designed to operate from d.c. power lines. A few receivers feature a.c.-d.c. operation. This article will consider only the case where an "a.c. only" type TV set is to be used with a d.c. source. The methods described here are applicable to 117 volt d.c. power line; 32, 24, 12, and 6 volt battery; and generator systems.

Inverters

The means of operating an a.c. device from a d.c. source is often called an inverter, converter, or a.c. generator. However, since only the word inverter applies exclusively to the device used for d.c. to a.c. conversion, it probably is the most generally used term. By connecting an inverter between the d.c. source and the TV receiver, the latter can be operated in the conventional manner. Actually there are some difficulties connected with this arrangement but before going into detail, consider the operation of the inverter itself.

Most service technicians familiar with auto radio repair work have already had contact with an inverter. In the car radio, power from the 6 or 12 volt battery is used to drive a vibrator, and the a.c. output of the vibrator is then stepped up by the power transformer. Basically, many inverters are nothing more than a vibrator and a power transformer with the necessary fuses and switches added.

There is one inverter, the *Carter* "Converter," shown in Fig. 1, which operates on a different principle. In this unit there is a d.c. motor driving an a.c. generator whose output is 115 volts a.c. The exact frequency depends on the speed of rotation of the generator and the d.c. input voltage, so that variations in d.c. line voltage result in variations of the a.c. output frequency. A separate, remotely located speed control, such as shown in Fig. 1, can be adjusted for best operation. The inverter itself can be located under the TV set or in a nearby closet, and the speed control can be placed near the controls of the TV set. In most instances, the adjustment will not have to be made too often.

The *Carter* "Converter" does not need an external interference filter and should operate satisfactorily with most TV sets. It is available in 6, 12, 28, and 115 volt d.c. versions with power capabilities ranging from 100 to 300 watts, sufficient to operate even a TV-radio-phonograph combination.

Fig. 2. A typical vibrator-type inverter with excellent frequency stability.

A completely different principle is used in the *ATR* television inverter shown in Fig. 2. The circuit diagram of this unit is shown in Fig. 3, and is typical of the vibrator type. One of the features of this unit is the use of r.f. filters both in the input and output circuit. The input filter, LF_1, removes any interference which might ride in on the d.c. line due to motors or other electrical devices. The secondary filter, LF_2, removes the harmonics generated in the vibrator circuit and helps assure a good 60 cps sine-wave output.

The main frequency-determining element in this inverter is the time constant of R_1 and C_1 which determines how the power is applied to the relay coil connected to terminals 3 and 4 of the vibrator. To get a good sine wave from the square-wave output of the vibrator, transformer T_1 is resonated at 60 cps through capacitors C_2, C_3, and C_4. Switch S_2 allows the service technician to select the output voltage from four taps of the transformer. This switch should be adjusted for about 117 volts with the TV receiver operating.

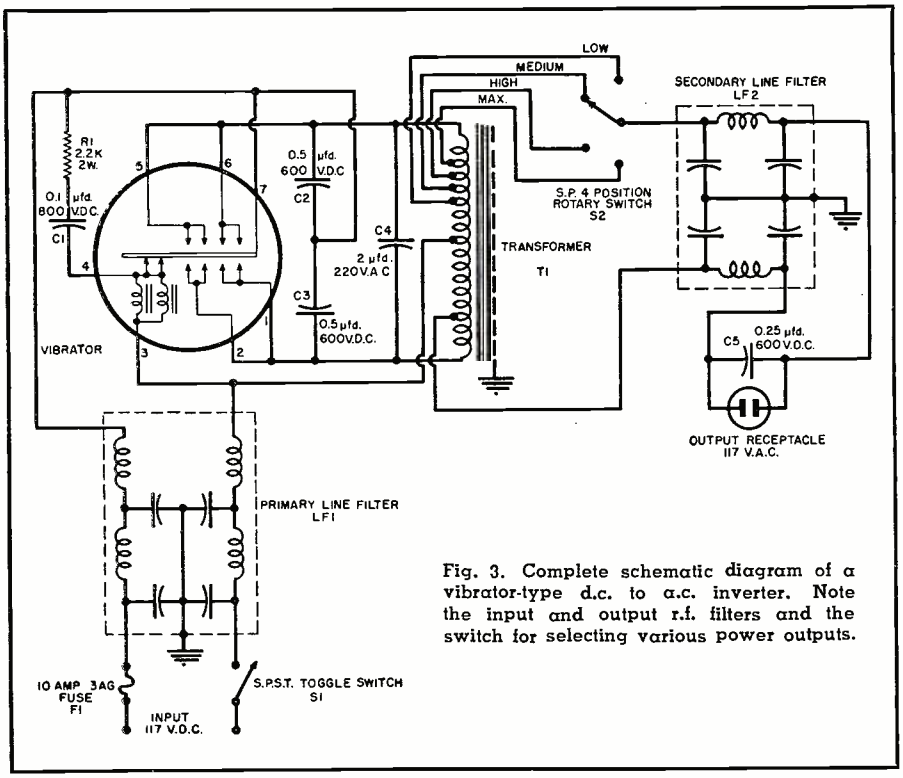


Fig. 3. Complete schematic diagram of a vibrator-type d.c. to a.c. inverter. Note the input and output r.f. filters and the switch for selecting various power outputs.

A somewhat different type of inverter is the *Cornell-Dubilier* "Powercon," shown in Fig. 4. The Model 110RT25 has two unique features which the service technician should know about. One is the frequency control which is accomplished by the adjustment knob visible at the top of the unit in Fig. 4. The other feature is a "phantom switch" which automatically turns the inverter on and off as the TV receiver is turned on or off. When the cover of the Model 110RT25 is removed, the two features are visible, as shown in Fig. 5. The special adjustable-frequency vibrator is shown plugged in at the rear, a 60 cps transformer with three taps is in the center, and the "phantom switch" is being inserted in the foreground.

The mode of operation of the "phantom switch" is apparent from the diagram in Fig. 6. When the TV set is connected and turned on, a small amount of d.c. passes through the TV power primary (or heater circuit) and this activates a sensitive relay which closes the d.c. switch to the vibrator. Since this d.c. is on the order of 1 milliampere, it will not affect the TV set operation. Note that a blocking capacitor separates the d.c. source from the a.c. power. This capacitor is a large electrolytic which has very low a.c. impedance and low d.c. leakage.

The adjustable-frequency vibrator and transformer circuit is shown in Fig. 7. In order to control the frequency with a simple potentiometer, the vibrator coil and contacting reed are specially designed and regular vibrators cannot be used. The circuit of Fig. 7 does not include the r.f. interference filters which are included in both input and output of the "Powercon." These filters are essentially similar to those shown in the circuit of Fig. 3.

Servicing Inverters

Generally, the part that becomes defective most often in a vibrator-type inverter is the vibrator itself. When working on such a problem it is absolutely essential that an exact replacement part be used. In rotary inverters, the most likely defect is deterioration of the brushes, and burnouts or shorts in the winding, commutator, etc. These troubles are electrical rather than electronic, and anyone familiar with electric motors and generators will be able to work on them.

In addition to the vibrator in inverters using them, the r.f. filter or one of the capacitors in the circuit may become defective. Simple ohmmeter checks will suffice to indicate whether electrolytic capacitors are good or whether a capacitor is shorted. To check for open paper or oil-filled capacitors, replace each temporarily with a good one.

Care should be taken in working on any inverter with the power on since, in effect, you are working across the power line.

In general, the service work required on inverters is quite small compared to the amount of trouble-shooting expected for a TV receiver during its normal life. Many service technicians in areas using d.c. power stock some replacement vibrators for the most frequently used inverters, but aside from that, no other special spare parts are usually stocked.

When the customer buys a TV set and wants it installed in a d.c. locality, it is up to the service technician to recommend a suitable inverter. The two major considerations are the d.c. input voltage and the power output required. Typical inverter models which can be used for the different input voltage conditions are as follows: For 6-volt input, the *Carter* Model A1013CT or the *ATR* 6THSH may be used. *Carter* Models B1013CT to B1030CT or *ATR* Model 12THSH may be used for 12-volt d.c. inputs. Twenty-eight volt inputs can take the *Carter* J1013CT or the *ATR* 28THSH; for 32 volts, the *ATR* 32THSH is applicable. For d.c. inputs in the neighborhood of 110 to 117 volts, there are the *Carter* D1013CT, the *ATR* 110TRSE, and the *Cornell-Dubilier* 110RT15. Other models by these manufacturers are also available for this input voltage range.

Carter, Cornell-Dubilier, and *ATR* all make various models providing from 150 to 400 watts for continuous operation. It is important to select the right power rating since, if the power consumption is less than rated, the frequency often will be off and the voltage excessive. Some of the inverter manufacturers list both intermittent and continuous power output, but for a TV installation only the latter figure, the lower one, is important. The customer will operate his TV set for hours without switching it off, therefore, the intermittent power rating of the inverter has little meaning.

Ascertain the power requirement of the TV set by checking the manufacturer's label or tag which is usually found at the rear of the receiver. Select a suitable inverter by matching the TV power rating with the inverter rating as near as possible. For example, if the TV receiver requires 300 watts and the two nearest inverter models are capable of 250 and 350 watts respectively, the latter should be chosen. If we select the 250-watt model, the 300-watt TV set will operate at low line voltage and the inverter will tend to overheat. The 350-watt inverter will run cooler, and although it will supply a slightly higher line voltage than 117 volts a.c., it will otherwise operate correctly. If we should choose a 400-watt inverter for the 300-watt TV set, the inverter load would be much too light and unstable operation might result. Of course, it is always possible to connect a light bulb of suitable wattage in parallel with the TV set to load down the inverter.

Aside from the ordinary installation problems which beset the service technician, a d.c. TV installation can also suffer from any one or all of the following:

1. vertical rolling
2. dark bar moving in picture
3. interference.

To avoid these three defects, it is a good idea to test the receiver first in the shop. If 117 volts a.c. is available, connect the set to the line and carefully adjust the vertical height, linearity, and hold controls. Next, allow the picture to roll slowly vertically and look for a dark stationary bar on the screen. Turn the contrast down and

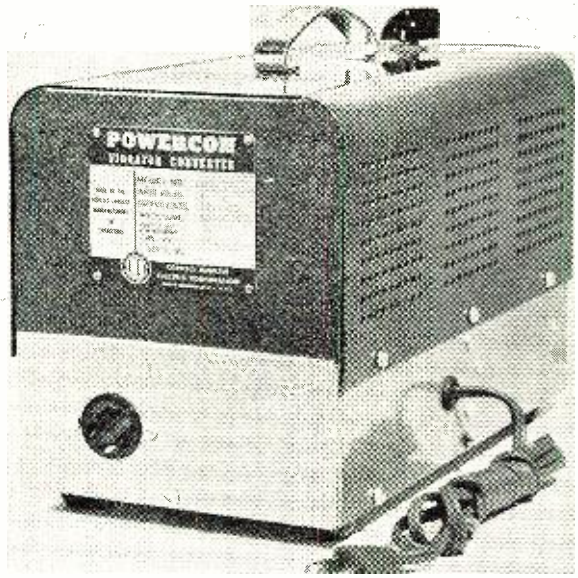


Fig. 4. Vibrator-type inverter with variable frequency control and automatic "on-off" switch which goes on with the set.

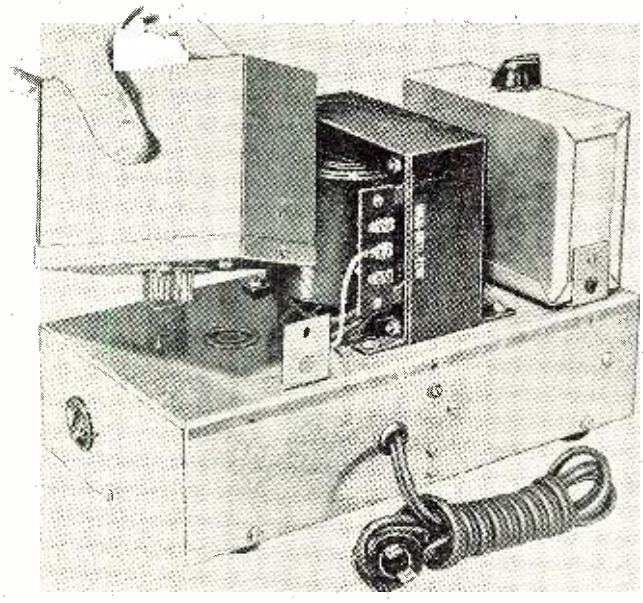


Fig. 5. Interior view of the vibrator-type inverter shown in Fig. 4. The automatic "on-off" switch is being plugged in.

the brightness up to see any such bar. This defect, if present, can be either a dark bar in the center of the screen, indicating 120 cps hum, or the upper half of the picture may be darker than the lower or *vice versa*, indicating 60 cps hum. The latter defect is most likely due to heater-to-cathode leakage in either the video or i.f. amplifier stages. Try replacing tubes to cure this.

The 120 cps or 60 cps hum interference may be very slight and may not be apparent when the set operates from the a.c. line which is synchronized to the TV station signal. When the picture is allowed to roll slowly up or down, this defect becomes apparent, just as it would appear when the set is operated from an inverter which is not locked exactly to the 60 cps frequency from the TV station. To cure a 120 cps hum condition may require additional filtering in the "B+" supply, and replacement or addition of some of the decoupling or filter capacitors.

The third type of installation trouble, interference due to the inverter itself, can be checked at the shop by operating the set first from the a.c. line and then from the inverter, if a suitable d.c. source is available. If such a source is not available in the shop, be sure to take some a.c. line and antenna filters along on the job.

Most of the inverters designed and sold for TV receiver work are well shielded and have good filters at the a.c. and d.c. terminals to keep any r.f. interference from the TV set. Occasionally, however, this filtering is not sufficient. The following general rules will help overcome r.f. interference due to the inverter and should be tried in sequence. When interference-free reception is achieved, the remaining steps can be omitted.

1. Locate the inverter at least 6 to 10 feet from the TV set. The inverter, especially if it has a "phantom switch" circuit, can be placed in a closet or an adjoining room, or even in the basement. This reduces the susceptibility of the TV set to direct radiation from the inverter.

2. Install the antenna lead-in line away from the inverter or the a.c. and d.c. power lines.

3. Short out the antenna terminals at the receiver to see if interference persists. If it does, it is mostly due to the a.c. line or direct pick-up. If the interference disappears install an antenna interference filter directly at the TV receiver. High pass TV filters are standard items in electronics parts stores.

4. Install a line filter. Typical plug-in types suitable are the *Aerovox* Model IN30, *Mallory* Model X3, and many others. The line filter is plugged into the a.c. output of the inverter and then the line to the TV set is plugged into the filter.

5. If a line filter reduces the interference but does not eliminate it, add an antenna high-pass filter.

6. Severe interference may require a heavy-duty a.c. line filter right at the TV set. The *Mallory* Model LC5 has its own line cord which can be plugged in at the inverter and then the coiled up TV set power cord is plugged into the filter. A still stronger filtering scheme is to wire a *Sprague* "Filterol 2" into each side of the line cord right inside the TV chassis, with the filter ground connected to the chassis.

7. If it is impractical to locate the inverter at a distance, and interference is caused by direct radiation, the interior of the TV cabinet may have to be lined with copper screening. In lighter interference cases, a bottom plate on the chassis may be sufficient. This is not feasible in most of the new vertical chassis TV sets.

Most d.c. installations will not require any of these extreme measures. After completing the d.c. installation, it might be wise to check back in the evening when the line voltage is usually lower to see if the vibrator frequency adjustment needs touching up.

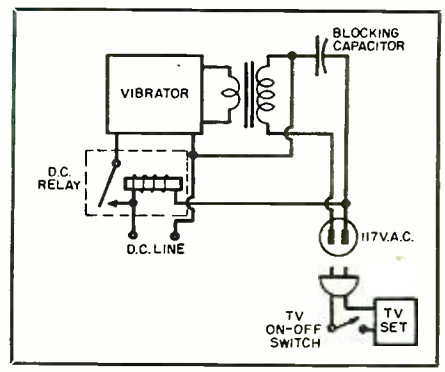


Fig. 6. Partial schematic diagram of the automatic "on-off" switch used in the vibrator-type inverter of Fig. 5.

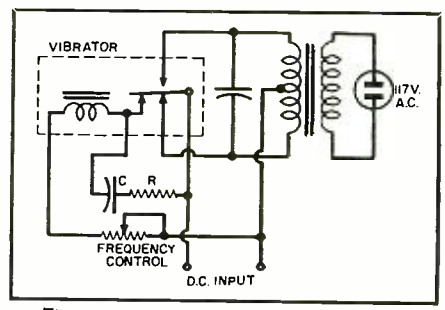
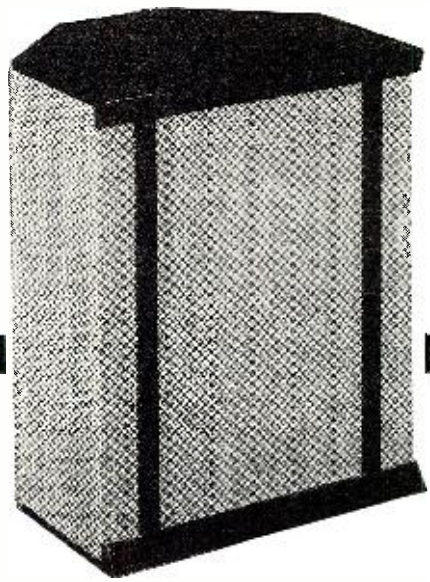


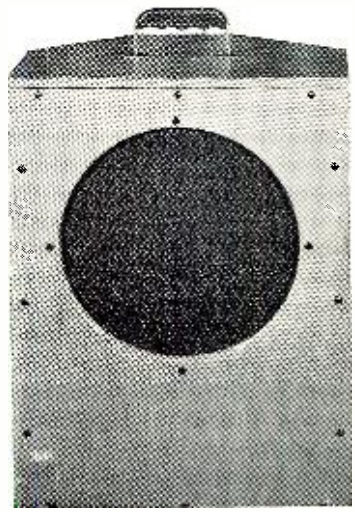
Fig. 7. Partial schematic diagram of the vibrator section of the inverter of Fig. 5. Note the frequency control.

Some of the inverters feature a special frequency control for two reasons. Sometimes, in an installation using an inverter, a slight 60 cps or 120 cps hum will exist if the 60 cps power from the inverter varies with time. Also, this variation may lead to vertical instability which simple adjustment of the vertical hold control may not remedy. To correct these effects, the inverter frequency control is adjusted until the inverter output is close enough to the 60 cps sync pulses to allow good vertical locking action. —30—

THE "REBEL 5"

By
JAY CARVER
Cabinart





Two models of the "Rebel 5," the one in fine woods (left) and the "utility" model (below) with a carrying handle for portability.

Construction data on a compact, portable speaker cabinet which is designed to be used with a 12-inch loudspeaker.

THE smallest of recent "Cabinart" developments in the field of corner horns is the 20-inch high "Rebel 5." The size and price of this particular cabinet might be misleading since, in reality, this enclosure offers excellent performance for so compact a design.

While crowded, the "Rebel 5" will accommodate a separate 3-way speaker with a 12" woofer with crossover points at 1000 and 5000 cycles.

Obviously the great, powerful boomy bass and tonal response which characterizes a "Klipschorn" are not available in this enclosure. Instead, this design gives a response which is as smooth for its size and as free from distortion as could be expected with the necessarily high crossover frequencies.

Naturally, the minimization of distortion requires that the response at the extreme bass end be attenuated. Therefore, if one compares the "Rebel 5" with the "Klipschorn" when playing organ music, one finds that the bottom couple of octaves are attenuated but the sound output remains clean. Its "controlled bass," or lack of a boomy peak of response, does not permit the diaphragm of the speaker or speakers to "free wheel," generating its own frequencies and cross modulating with the signal. Surprisingly, on lighter music of the piano (and especially if the repertoire avoids the lower octave) one has to listen closely to detect the difference between the "Rebel 5" and the "Klipschorn." Of course, it is assumed that the "Rebel 5" in this instance is driven by a 12" bass cone with a heavy magnet, a horn-loaded mid-range unit, and an extended-range tweeter.

The choice of drivers for the "Rebel 5" can be determined by applying the following criteria: In the $40-$60 price range, the best choice would be two-way coaxials incorporating horn-type tweeters. The single voice coil speaker is not advisable with this design because of the distortion and lack of definition which may result. Drive systems in the $80-$120 class may be built up from a 12" cone woofer, a mid-range driver of the "ball park" type on a short horn, a tweeter, and a crossover network. In the case of woofers, high-efficiency units with light magnets should be avoided.

Assuming use of mid-range and tweeter systems, the squawker or mid-range unit as applied to the "Rebel," is required to cover slightly more than two octaves. Preferred are the public address type, compression units using a 2" diameter phenolic diaphragm. The tweeter must be of the type which is free from peaks in the 5000 to 10,000 cps region or an unnatural "presence" peak will exist. Preferable is a diaphragm not larger than ¾" of the phenolic type to produce the internal damping of transverse waves within the diaphragm and a horn not to exceed 3" in length with an adequately small throat for proper loading.

A crossover network for a multiple system in the "Rebel 5" should be one having a 6 db/octave slope instead of the type having a sharp cut-off. When using separate, 3-way drive systems in this enclosure it is possible to achieve the same response and freedom from distortion above 1000 cycles as are available in the "Klipschorn" in the same frequency range. This means that the reduction in size and cost has resulted in a sacrifice in tonal response only in the region below 1000 cps.

With performance such as this, the enclosure is suitable to recording monitoring applications, for use with portable motion picture projection units, and in home sound systems where space is at a premium.

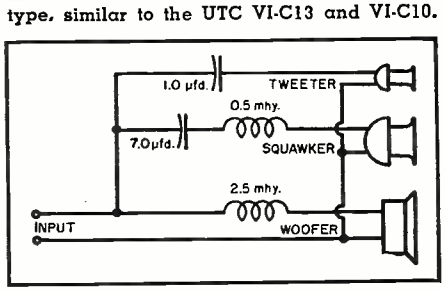
The "Rebel 5" is the third of a series of "Rebel" cabinets put out by *G & H Wood Products Company,* 75 North 11th Street, Brooklyn 11, N. Y. in its "Cabinart" line.

The first, the "Rebel 3" was the largest unit and was designed especially for 15" speakers. The "Rebel 4" was offered in both 12" and 15" versions, the former being described in the October 1953 issue of RADIO & TELEVISION NEWS.

This "Rebel 5" is actually the smallest of the group and was designed primarily for use where space is an important factor and portability is desired. It has one added feature in that although best performance is obtained when used in a corner, it does incorporate its own corner horn making it possible to use it against a flat wall. The other two versions did not include this feature.

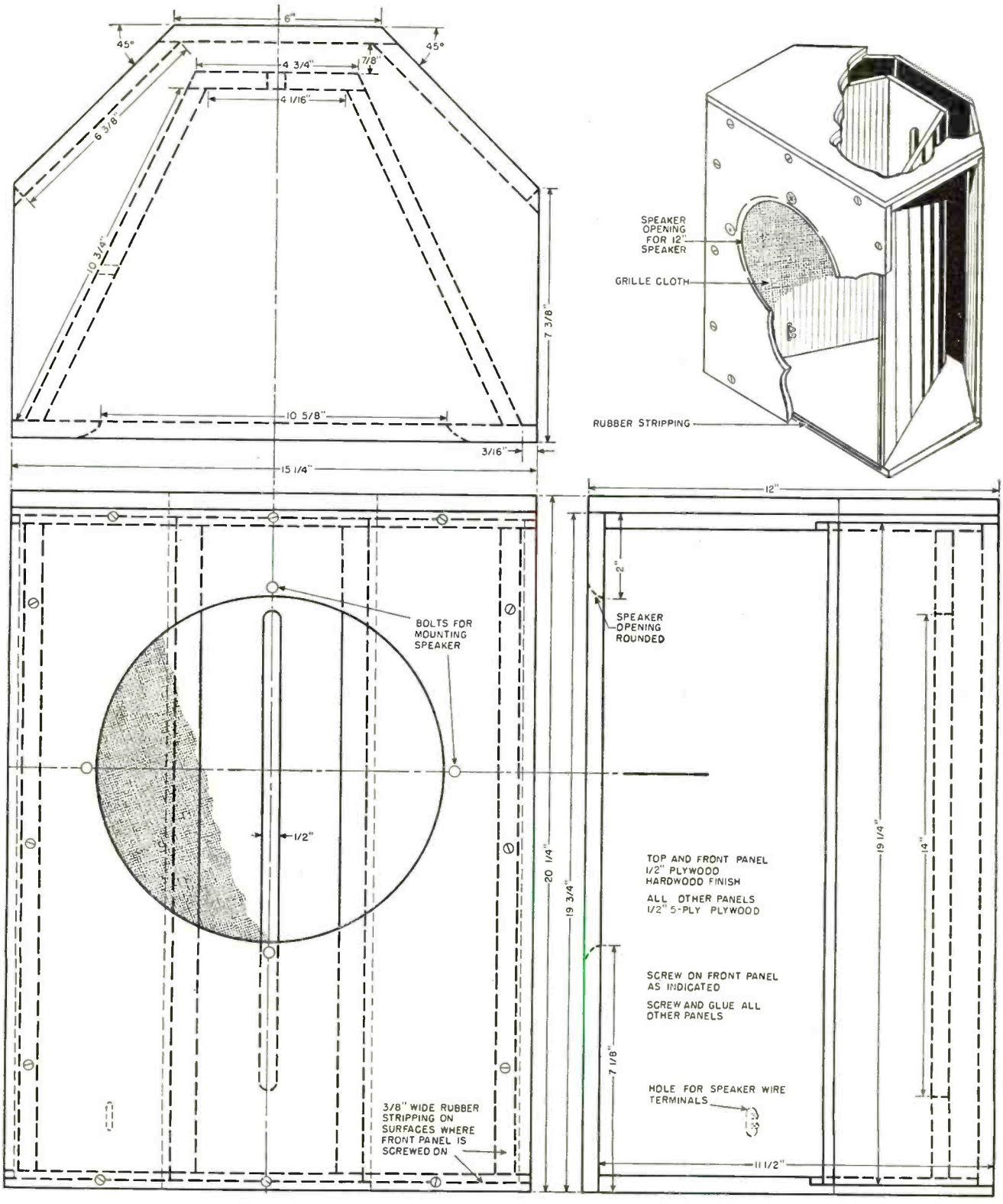
The "utility" version of the "Rebel 5" is priced less than $35.00, cut for 8" or 12" speakers and under $50.00 for the versions in fine woods and leatherette. All required cutouts for the loudspeakers to be used are included in the net prices. Both the portable and fine-wood models are shown in photos above. —30—

Suggested crossover network for three-way "Rebels." Constants given are for a 16 ohm voice coil with 1000 and 5000 cycle crossover frequencies. Since this network is a special design, it would have to be made up of individual components. The inductors used are of the variable type, similar to the UTC VI-C13 and VI-C10.



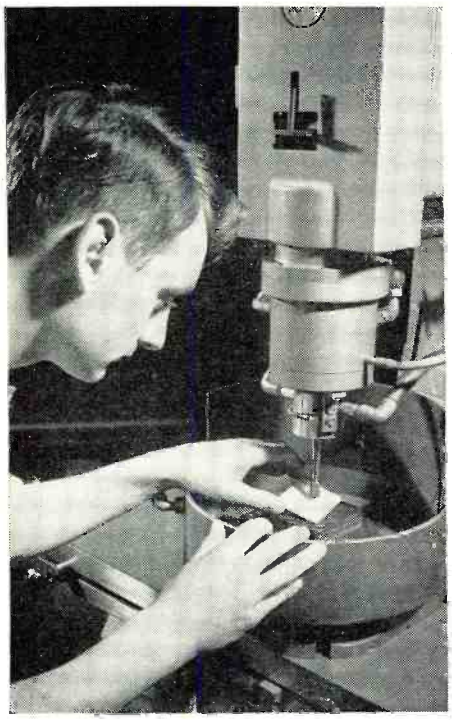
Mechanical Details on the "Rebel 5" 12" Speaker Cabinet

Additional notes on the construction: This enclosure is designed for use with any three combinations of speakers: 1. A single 12" coaxial speaker incorporating a woofer and tweeter. 2. The coaxial unit of (1) with the addition of a separate high-frequency horn. The tweeter of the coaxial unit would then serve as a mid-range unit. 3. Individual units consisting of a woofer, squawker (mid-range) and tweeter. Note that the additional cut-outs for the mid-range and tweeter units are not shown in the mechanical details below. Obviously, the size of the cut-outs would depend on the particular units used. They can, however, be added to this enclosure. To do so, simply invert the cabinet or the mounting board so that the woofer unit is at the bottom of the enclosure. Add the other units above the woofer and assemble them directly to the mounting board.

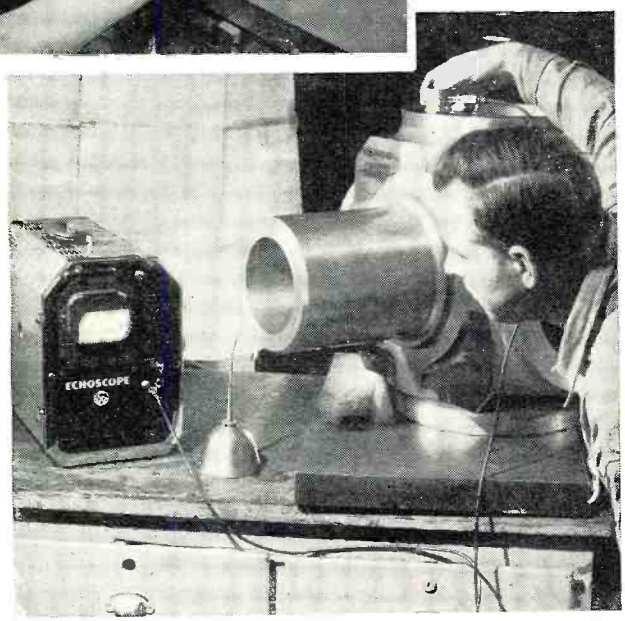


THE SCIENCE OF

Curtiss-Wright has introduced a whole series of devices covering applications from quality control to dentistry.



Various shapes may be cut in ceramics, metals, or glass by means of the ultrasonic drill which bores without rotating. A rapidly moving head drives an abrasive solution through the surface of the work piece.



A large hub is examined ultrasonically with an "Echoscope." Location of flaws, if they exist, shows on the scope screen. Transducer-receiver operates on the impulse-echo principle.

THOSE sound waves that travel in the ultrasonic region (above 20,000 cps) are being utilized in a wide variety of applications ranging from equipment for quality control, manufacturing, food processing, medicine and dentistry to brewing, and industrial and scientific research.

The fact that an ultrasonic wave has the ability to penetrate thick metal pieces and traverse the length of a steel beam yet is stopped by an air pocket is the secret behind the operation of a whole series of non-destructive testing devices.

In other applications, ultrasonics relies on the harnessing of large numbers of vibrations per second to move molecules of which all matter is composed. This explains its ability to mix liquids, for example, more thoroughly than by any normal mechanical means such as agitation and paddles.

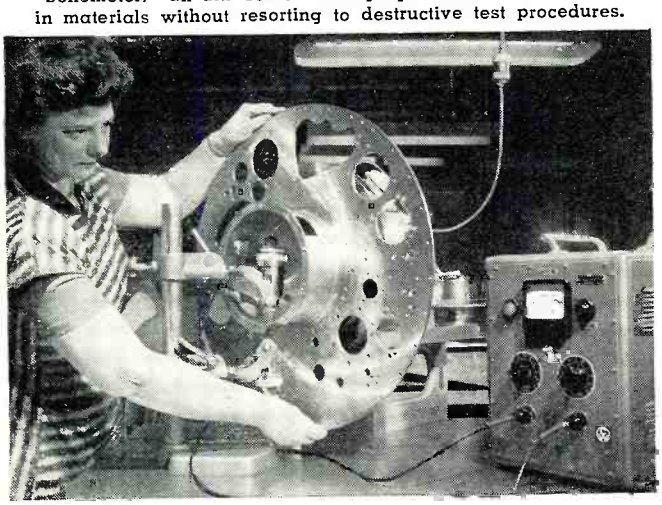
Electronic instruments, similar to radio transmitters, are used to make ultrasonic waves by expanding and contracting a material able to convert electrical energy into ultrasonic oscillations or pulsations. These materials include magnetic metals, certain crystals, and some ceramics. When placed in a changing magnetic or electrical field, these materials change physical shape. In metals this characteristic is called megnetostriction. Crystals and ceramics with this property are known as electrostrictive or piezoelectric materials.

In the rapidly alternating field, the material expands and contacts at frequencies from 20,000 up to 500 million times per second. This is the source of the waves that do the work in the science of ultrasonics. From there on, the problem is simply one of applying a suitable soundhead directly to the material in work.

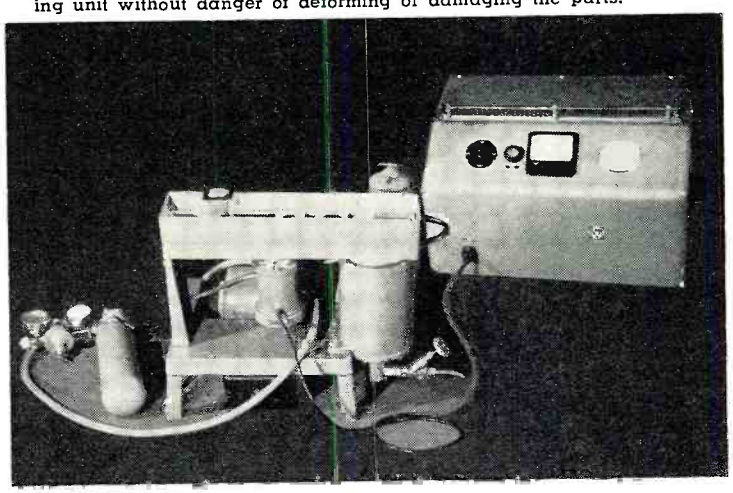
Using this basic principle, *Curtiss-Wright Corporation* is producing an extensive line of ultrasonic equipment for industry and science under license from *Dr. Lehfeldt and Company* of West Germany.

Among the unique devices now ready are ultrasonic washing units which are designed for cleaning and degreasing delicate foils and small and large metals parts

Rapid inspection of large metal parts is facilitated with a "Sonometer," an ultrasonic "seeing eye" that locates defects in materials without resorting to destructive test procedures.



Delicate foils, tiny gears, and other metal objects can be quickly and thoroughly cleansed in the ultrasonic parts washing unit without danger of deforming or damaging the parts.



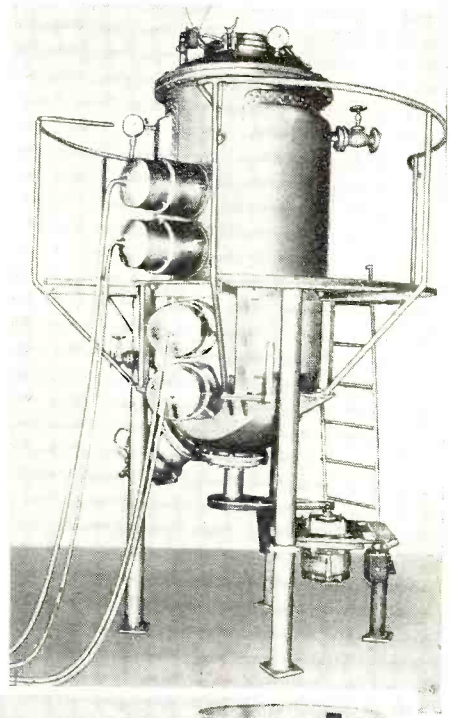
ULTRASONICS

which could easily be damaged by mechanical or chemical cleansing processes; a "Sonometer" which locates defects in materials however close to the surface. This device incorporates a sonic transmitting head which sends a beam directly through the entire test object to a separate receiver; an ultrasonic drill that is capable of cutting intricately shaped holes in metals and ceramics in a single operation; and an ultrasonic echo device which detects flaws in metal, measures the thickness of materials, and computes fluid content.

In the medical, laboratory, and food processing fields the company has demonstrated an ultrasonic therapy device which is especially valuable in the treatment of osteohypertrophic and degenerative arthritis, bursitis, neuritis, sciatica, myalgia, fibrositis, sprains and strains, and forms of chronic superficial ulcers; a unit that painlessly anesthetizes teeth without injections which has proven advantageous in preparing painful cavities, quick iontophoresis, pain therapy, preparation of vital pulps, pulp test and high-frequency minor surgery; in the laboratory and food processing realms the ultrasonic "Conche" is designed to provide rapid homogenization of chocolate; while an ultrasonic hops extractor that improves the flavor and quality of beer at the same time cutting production costs is also being offered.

In the medical field one of the primary advantages, according to the company, is that no extensive training is required of the technician who administers the treatment. Since these therapy units are available in both portable and office models they provide a flexible tool for the physician. They are designed to be used in two different ways, one the direct method whereby the skin is well oiled and the transducer slowly moved over the area, and the indirect method involving the submersion of the part to be treated in water and then placing the transducer about one-half to one inch away from the affected part. The treatments are designed to be administered in a series of eight to twelve treatments at intervals of 48 hours with each treatment averaging from 3 to 10 minutes.

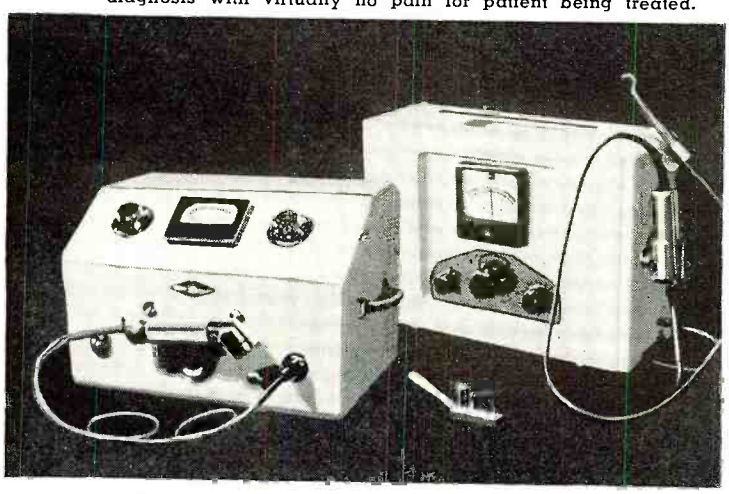
All of these devices offer unique advantages to the industrialist, the doctor or dentist, and the laboratory technician in that ultrasonics provides a rapid, precise, and thorough method of handling the job at hand. The advantages of ultrasonic techniques in industry are many in that it saves both time and materials. -30-



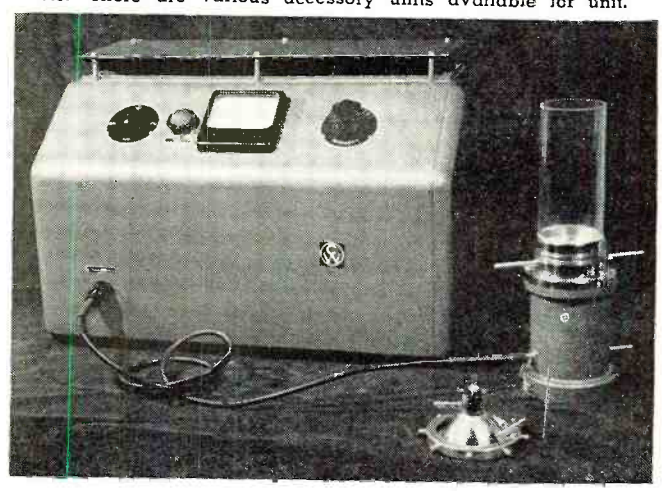
Ultrasonic hops extractor used to improve flavor of the beer and reduce amount of hops needed by nearly 50 percent in extraction and separation of aromatic and bitter substances. Process also improves shelf stability and retards sedimentation.

The "Conche" ultrasonically homogenizes chocolate masses in a matter of seconds. The process improves flavor, makes the chocolate easier to work, saves time, waste, and floor space.

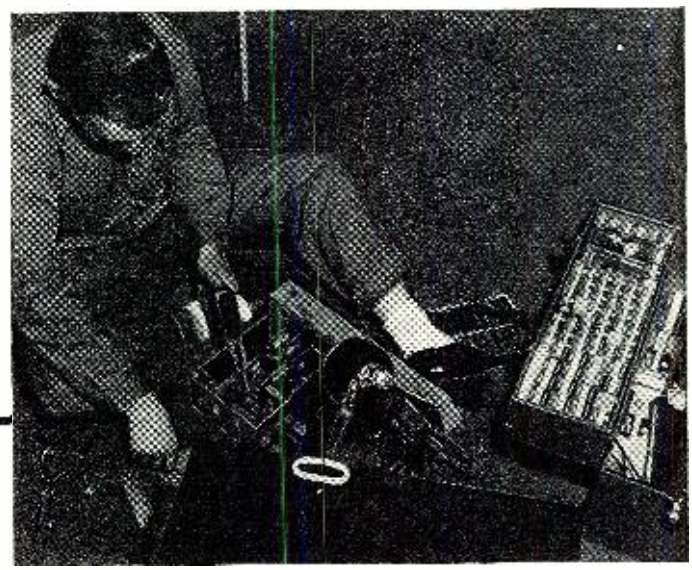
An ultrasonic therapy unit (left) and the "Dentatron" unit (right)—both designed to facilitate medical treatment and diagnosis with virtually no pain for patient being treated.



One of the ultrasonic laboratory units for research and small production in the fields of bacteriology, chemistry, nutrition, etc. There are various accessory units available for unit.



WHEN SHOULD YOU PULL A CHASSIS ?



The type of servicing in the home shown by this illustration is definitely not recommended. It is inefficient, degrading, and can result in damage to furniture and rug.

WITH the multitude of different troubles that may befall a TV receiver, the ailment cures range up and down the scale from the ridiculously easy to the incredibly difficult. The easy repairs can be dispatched neatly and inexpensively in the home, while the real toughies have to be taken into the shop for costly bench scrutiny. Where should the line be drawn? At what point on the "difficulty scale" should you cease all home attempts and pull the chassis into the shop?

These questions pose a ticklish problem, for in all fairness to yourself and the service business you are connected with, the cold facts of profit and loss must be considered. On the other hand, you must honor the trust the technically uninformed set owner places in you, by not permitting him to pay exorbitant or unnecessary charges.

Picture Tubes

Our service company advocates pulling almost all picture tube jobs. This is a safe procedure since it eliminates implosion dangers. However, there is another important factor. A very human TV service technician will occasionally err in his analysis of what is wrong, but if the chassis is perched on the bench, the blunder is of little consequence.

For example, one of our technicians was called out to repair a 21-inch *Philco*. It had no brightness. A cold 6AX4 damper tube was quickly located and the picture blossomed in. Then he checked the rest of the set. He found the brightness control fixed at a fairly high level. No amount of turning the "pot" would alter the setting.

He informed the customer of the condition. The set owner told him that the brightness control had never worked; she thought it was supposed to be that way. The service technician explained she had a shorted electron gun in her picture tube. All was well though, for the receiver was only about six months old. The technician sold her on the idea of exchanging the defective warrantied CRT. He then pulled the chassis into the shop and sent the CRT to *Philco* for exchange. However, the distributor surprised everyone by refusing the exchange. After checking the tube they came up with the amazing statement that the tube was good.

The technician tried a different tube in the chassis. It, too, reacted with the same fixed brightness condition. A bit of frantic ohmmeter checking found the cathode connection of the CRT at ground potential. This was dead shorting out the brightness "pot." Thereupon it was discovered that a wire stretching across the brightness control to the CRT cathode was wedged tightly beneath a selenium rectifier. The pressure had damaged the insulation of the wire. By fixing the bad wire the brightness control was restored. Luckily, the service technician had pulled the chassis. What would have happened if he had tried to install a new picture tube in the home?

Another time, one of the boys was out looking at a 12-inch *Du Mont*. It also exhibited the classic fixed brightness symptoms. He sold the customer on the idea of a new picture tube, then he pulled the chassis. On the bench, the condition turned out to be a little different. Upon turning the "pot," the brilliance would vary a slight bit. A .05 μfd. capacitor leading from the video amplifier into the CRT grid was shorted, putting "B+" on the grid. This caused the defective CRT symptoms.

On occasion, though, the customer puts a fly in the ointment. He decides that the CRT changing must take place in the home. Although disagreeable, from an objective business point of view it is not good to lose the sale. We've changed lots of CRT's in the home under these circumstances. One of our technicians was looking at a 12-inch *Emerson* that had no raster but plenty of high voltage. The heater of the picture tube was lit. The high voltage lead was found to spit purple death nicely to the chassis, but would not spark at all into the picture tube well. An open CRT cathode was suspected, although there was the lesser possibility of an open resistor in the CRT circuit. The rugged individualistic set owner had his own ideas on the subject. He insisted on the picture tube replacement taking place in his domain. Rather than lose the sale, the technician agreed. He took a deposit and left.

The following day he returned with a new picture tube and fortunately the installation confirmed his suspicions. Everybody concerned was happy. The service technician collected the money and breathed a sigh of relief. He didn't have to use the alternate explanation he had prepared or any of the bevy of resistors he was carrying for the occasion.

Upon customer demand, we will go ahead with an occasional parlor floor CRT changing, but we do not as a rule think it is the wisest method. The job can be handled in a much safer and more expert fashion on the shop bench.

In order to install a new CRT in the home you must make an extra trip to obtain the tube anyway. Instead of leaving with a deposit and coming back with a boxed CRT, you can leave with the chassis and come back with a working receiver. Then you can install the set with a comfortable feeling, knowing everything is right, rather than with a half formed prayer that everything will go as hoped.

Obvious Bad Parts

What about other repairs? When should home service investigations stop and the chassis be pulled?

The only sure way to troubleshoot a receiver quickly and expertly is on the shop bench with test equipment and schematic diagrams.

Every service shop should have a definite understanding on this— here are a few recommendations for better customer relations.

By ART MARGOLIS

Allowing for exceptions, our company decided that we should change in the home any part that is definitely proven bad. This includes tubes, fuses, capacitors, resistors, selenium rectifiers, etc. On one house call involving a 12-inch *Admiral,* the symptoms were poor sync and a moving weave. Checking through the tuner, i.f., video, and sync tubes showed nothing. The chassis was taken out of the cabinet and the technician poked around beneath the sync tubes with an ohmmeter. There, coming off the 12AU7 sync separator plate, was a .02 μfd. capacitor that measured three ohms. (See Fig. 1.) The solder gun unhooked it and a new capacitor was quickly installed. The picture locked in.

The only thing is, you must be very careful with these obvious troubles. On one job in a customer's home, a 21-inch *Philco* displayed a small square gleam of illumination that wouldn't have been enough to grace a scope tube. Without hesitation, the bright orange rectifiers were replaced with a pair of sky blue ones. Sure enough, it spread the picture out, but not enough. Also, the sides of the picture now had a 120-cycle ripple. Without further ado, the chassis was pulled.

In the shop, it was discovered that one of the 120 μfd. filter capacitors had decided it didn't want to be a capacitor any more and had transformed itself into a big fat 40 megohm resistor. A new capacitor was all that was needed to complete the repair.

Other times you will easily spot an obviously bad part, but it is not sensible to change it in the home. Such troubles as faulty tube sockets and bad flyback transformers fall into this category.

A 21-inch *Muntz* that was checked in the home had snow on all channels. When a voltmeter probe was placed on the 6BZ7 r.f. amplifier plate connection, "B+" was missing. The chassis was pulled and, in the shop, an open 1500 ohm plate load resistor was located in the tuner. In this case, it would definitely have been a messy job to change the resistor in the home.

If you do not know the exact part that is causing the trouble in a TV set, without really digging, the repair job should not be accepted unless you can pull the chassis into the shop. Extensive troubleshooting on a set owner's living room floor or rug cannot be done satisfactorily or profitably.

Before adopting this rule, one of our boys was out looking at a 16-inch *Admiral.* He found that there was no raster or high voltage; however he discovered a unique phenomenon. If he pulled out any of the video i.f., detector, or video amplifier tubes, both the high voltage and raster would sing on.

He pulled the chassis out onto the floor, opened up a service schematic manual, and began checking voltages. After about an hour and a half of squirming and sweating, he rooted out an open 100,000 ohm resistor. (See Fig. 2.) It was one of the twin balancing resistors across the 6AL5 horizontal phase detector. Being open, an unbalanced sync pulse was fed to the horizontal oscillator grid, 180 degrees out-of-phase with the sync signal. This positive voltage killed the oscillator which, in turn, could produce no high voltage. If the technician extracted any of the video tubes there would be no sync. The 6AL5 did nothing and permitted the oscillator simply to run free.

Before the chassis was re-installed and all details taken care of, better than two hours had elapsed. The set owner called a few hours later, at the same time the technician was telling us how he licked this dog. She told us loudly, "You people have a heck of a nerve sending out that inexperienced man. I had to pay for over two hours labor just for a little resistor. And he never would have found it then if he hadn't looked in his book!"

Another time, one of our men was in a home working on a 12-inch *Philco.* The video was extremely strong even at minimum setting of the contrast control. The too dark picture was intermittently breaking into sync and weaving. New tubes didn't help at all. The chassis was pulled out of the cabinet and turned on its side. All voltages seemed right except the bias on the i.f. tubes. They were a bit too positive. Some parts were unsoldered, their resistances were checked, and then resoldered. The technician was completely stumped.

Finally, he told the customer that the chassis must go. She snapped back, "Sure, first you throw my television around on the floor, then burn up all the parts underneath. No wonder you have to take it to the factory. You broke it and don't know how to fix it!"

After a couple of hours on the bench with the little monster, the technician had to admit that maybe he didn't know how to fix it. Then he consulted his *Philco* service notes. By the greatest stroke of fortune they told about this model and this special condition.

(*Continued on page* 131)

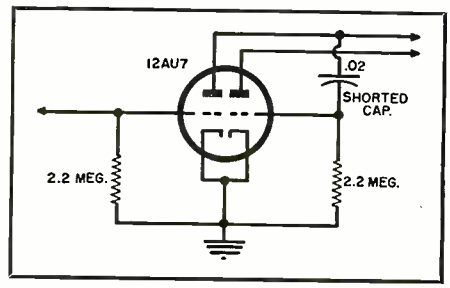
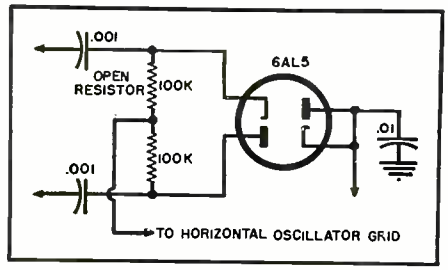


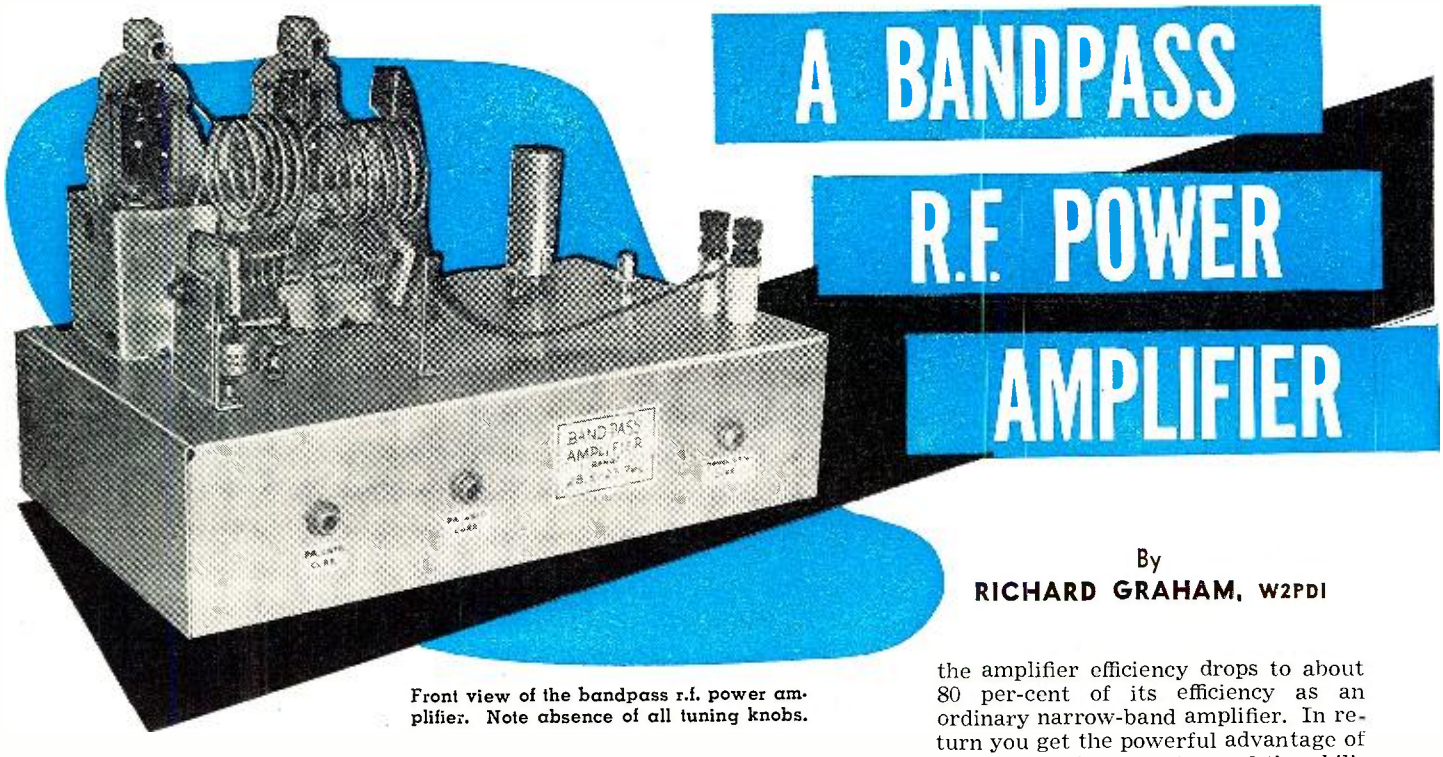
Fig. 1. The .02 μfd. capacitor coming off the 12AU7 sync separator plate measured three ohms in this circuit, resulting in poor sync. Such a condition can be detected and repaired on a house call.

Fig. 2. Lack of high voltage was traced to an open 100,000 ohm resistor in this horizontal phase detector circuit.



A BANDPASS R.F. POWER AMPLIFIER

By
RICHARD GRAHAM, W2PDI



Front view of the bandpass r.f. power amplifier. Note absence of all tuning knobs.

Details on a unique unit which permits operation over an entire amateur band without need for tuning adjustments.

A BANDPASS amplifier—what's special about it? Nothing that hasn't been commercially exploited, but something most hams have been missing out on. Many a ham's ideal is a transmitter that will stay tuned up over the entire band. Toward this end, a number of good articles have appeared featuring a broadband or gang-tuned transmitter. A few have used a double-tuned stage in the exciter. But virtually all have required some sort of power amplifier tuning adjustments. Well, this amplifier provides an answer for these particular gentlemen for there are no knobs to turn or adjustments to make (other than the v.f.o.) over an entire amateur band. There is no grid tuning, no power amplifier tuning, or antenna peaking.

The method of accomplishing this is quite straightforward and a detailed explanation can be found in any radio engineering handbook. However, briefly, when two tuned circuits are coupled together a flat-topped type of response curve can be obtained by careful adjustment of the resonant frequencies of the tuned circuits, the coupling between the tuned circuits, and the effective loading across the secondary tuned circuit. The application of these bandpass or double-tuned circuits is quite common in TV set i.f. strips (at least the older models) and many television transmitter power stages.

This amplifier isn't intended to be the answer to every operator's prayer for it has a few minor drawbacks which will be explained. First, it admittedly is more difficult to tune up, but once it is adjusted it's done for once and for all—just like a TV set i.f. strip. Secondly, it can only be used with a broadband antenna such as a folded dipole. The third item is that the amplifier efficiency drops to about 80 per-cent of its efficiency as an ordinary narrow-band amplifier. In return you get the powerful advantage of convenience in operating and the ability to change frequencies as fast as you can turn the knob of the v.f.o.

The particular amplifier described and shown schematically in Fig. 3 is designed for the ten-meter phone band —this being the writer's particular favorite. However any band of the builder's choice can be used by changing the coils and tuning capacitors to resonate in the desired band. The principles and tuning up procedure are still the same.

Double tuning the output stage of the transmitter, when properly adjusted, permits a constant power output to be developed over the entire band of frequencies from 28.5 to 29.7 megacycles. Broadbanding the usual single-tuned transmitter output circuit by means of lowering the tank circuit capacitance or increasing the load would result in very low efficiency since the load resistance that the tube sees drops as the bandwidth increases. For example, the load resistance that the tube sees for a practical amplifier would be given by the following equation.

$$R_L = 1/(2\pi \Delta f C) \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

Where:

Δf = bandwidth between half power points

C = tank circuit capacitance

C is on the order of 30 $\mu\mu$fd. This value is dictated by the output capacity of the tube or tubes. The bandwidth Δf would have to be quite wide if the response curve and hence the power output is to remain fairly constant over the band. With a single-tuned circuit the response can never be made flat and therefore the power out can never actually remain constant. However letting the bandwidth equal 5 megacycles and substituting in equation (1) will give us a typical value of load resistance.

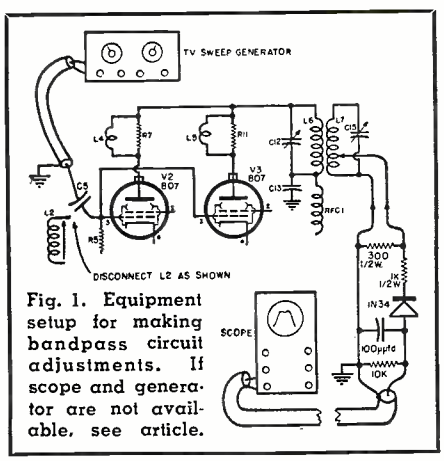


Fig. 1. Equipment setup for making bandpass circuit adjustments. If scope and generator are not available, see article.

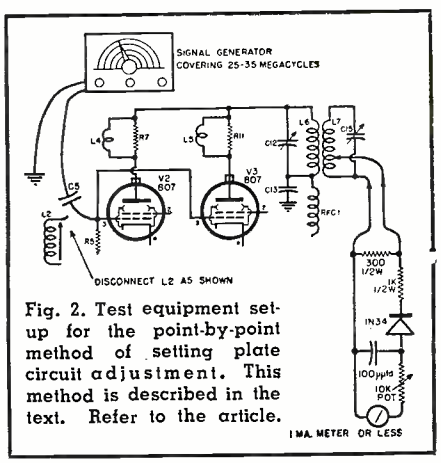


Fig. 2. Test equipment setup for the point-by-point method of setting plate circuit adjustment. This method is described in the text. Refer to the article.

$$R_L = \frac{1}{(6.28)(5)(10^6)(30\times10^{-12})} = \frac{800}{\text{ohms}}$$

The "Q" of such a circuit would be quite low as shown by substituting in the following:

$Q = R_L/X_C = 800/177 = 4.5$ . . (2)

Such a low tank circuit "Q" means high harmonic output with consequent TVI problems. This is in addition to the very low efficiency to be expected with the tube working into an 800 ohm load. Thus broadbanding in this manner is quite impractical.

However by double tuning the output the low "Q" and low efficiency can be improved tremendously. The bandpass characteristic of a double-tuned transitionally-coupled circuit, *i.e.*, a double-tuned circuit adjusted to produce maximal flatness on the top of the bandpass curve, is illustrated in Fig. 4. The characteristic curve of a broadbanded single-tuned circuit is also included for comparison.

The top of the curve in Fig. 4 is flat which means a constant power output. The sides are steeper than the single-tuned broadbanded circuit shown which infers a higher load resistance for the tube. This is more rigorously shown by the following. The load resistance R_L in this equation is that seen by the tube working into a transitionally-coupled, double-tuned circuit.

$R_L = 1(\sqrt{2}\pi\Delta fC)$ . . . . . (3)

where:

Δf = Bandwidth between half-power points

C = Primary tank circuit capacity.

Since the sides of the curve for the double-tuned circuit are steep, the bandwidth Δf can be conservatively given as 3.5 megacycles if only 1.2 megacycles are desired flat.

Substituting in equation (3):

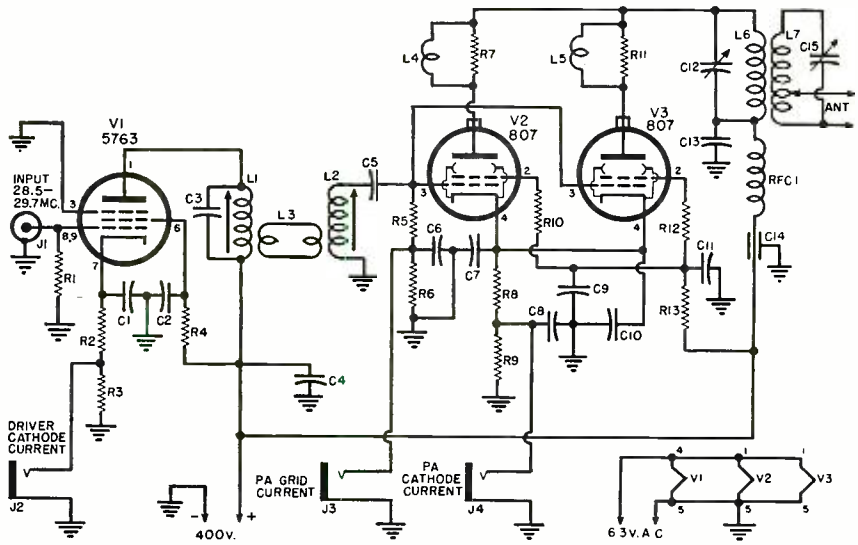
$$R_L = \frac{1}{(1.44)(3.14)(3.5)(10^6)(30)(10^{-12})} = 2140 \text{ ohms}$$

The "Q" of the primary circuit is now up to 12. This value is within the usual design values of 10 to 20 for amplifier tank circuit "Q." At the same time the load that the tube sees is increased 2.7 times over the previous case of a broadbanded single-tuned circuit. This means that for the same plate current flowing through the tube, 2.7 times the power can be developed.

Now finally, let's compare this double-tuned circuit to the usual narrow-band single-tuned circuits used in most transmitters. Let's assume a middle value of "Q" of 15. At an operating frequency of 30 megacycles, the bandwidth of such a circuit is 30/15 or 2 megacycles. Substituting in equation (1); R_L would then equal:

$$R_L = \frac{1}{(2)(3.14)(2)(10^6)(30)(10^{-12})} = 2650 \text{ ohms}$$

In the double-tuned circuit, the load resistance was calculated to be 2140 ohms. Comparing this to the 2650 ohm



R_1—15,000 ohm, ½ w. res.
R_2—500 ohm, 2 w. res.
R_3, R_6, R_9, R_{10}, R_{12}—47 ohm, ½ w. res.
R_4—27,000 ohm, 2 w. res.
R_5—6000 ohm, 1 w. res.
R_7, R_{11}—47 ohm, 2 w. res.
R_8—200 ohm, 5 w. wirewound res.
R_{13}—10,000 ohm, 5 w. wirewound res.
C_1, C_2, C_7, C_{10}—.005 μfd. disc ceramic capacitor
C_3—22 μμfd. tubular ceramic capacitor
C_4, C_6, C_8, C_9, C_{11}—.001 μfd. ceramic stand-off capacitor
C_5—100 μμfd. mica capacitor
C_{12}—25 μμfd. var. capacitor
C_{13}—1000 μμfd. ceramic capacitor
C_{14}—1000 μμfd. ceramic feedthrough capacitor
C_{15}—35 μμfd. var. capacitor
L_1—10 t. #24 wire, ½" dia. slug-tuned form
L_2—8 t. #24 wire, ½" dia. slug-tuned form
L_3—Link consisting of 2 t. each on L_1 and L_2. Use hook-up wire
L_4, L_5—8 t. hook-up wire wound over R_7 and R_{11}
L_6—5 t. #12 wire, 1⅜" dia., airwound
L_7—6 t. #12 wire, 1⅜" dia., airwound
RFC_1—R.f. choke, 21 μhy., 600 ma. (Ohmite Z-28)
J_1—Coax connector
J_2, J_3, J_4—Open-circuit jack
V_2, V_3—807 tube *V_1—5763 tube*

Fig. 3. Schematic diagram and parts list covering bandpass r.f. amplifier.

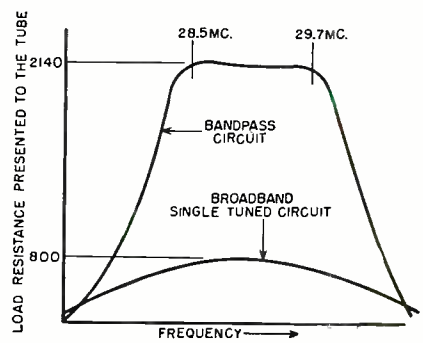


Fig. 4. Comparison of frequency versus load resistance for a single-tuned broadbanded circuit and double-tuned circuit.

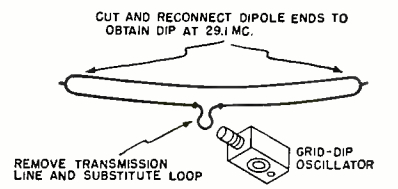
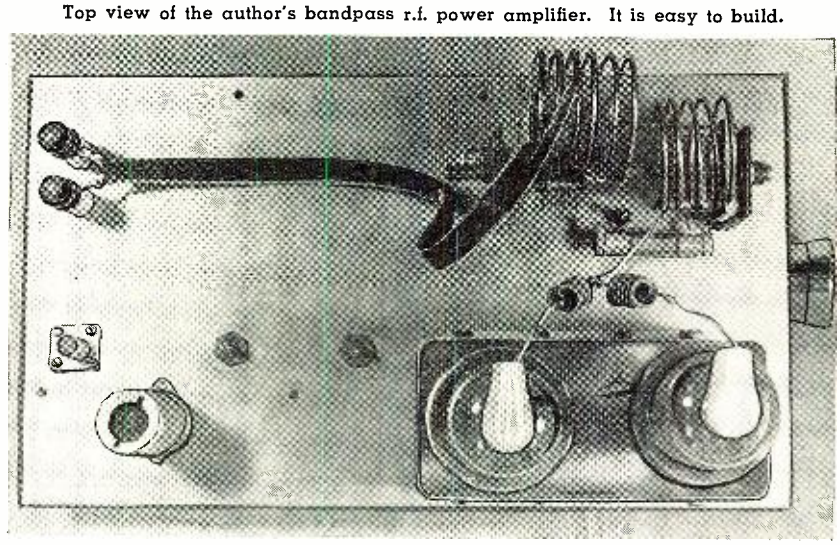


Fig. 5. Method of getting the antenna resonant to the center of the band. See text.

Top view of the author's bandpass r.f. power amplifier. It is easy to build.



BANDPASS CHARACTERISTIC AS SEEN ON SCOPE	DEFECT	REMEDY
	NONE	NONE
	NOT ENOUGH LOADING ON SECONDARY	MOVE ANT. TAP ON L7 UP TO FILL VALLEY
	CIRCUIT TOO HEAVILY LOADED	MOVE ANT TAP ON L7 DOWN TO REDUCE LOADING
	BANDWIDTH TOO WIDE	REDUCE COUPLING BETWEEN L6 AND L7
	BANDWIDTH TOO NARROW	INCREASE COUPLING BETWEEN L6 AND L7

Fig. 6. Bandpass characteristic of a double-tuned transitionally-coupled circuit under various operating conditions.

load which would normally be used means that the efficiency has dropped to about 80 per-cent of what we would normally expect. This means that for the same plate current we will get 20 per-cent less power out for the convenience of operating the amplifier in this manner.

Outside of the bandpass coupling networks in the grid and plate circuits of the 807's, the amplifier is quite conventional. A 5763 pentode serves as a driver for a pair of 807's operating in parallel. Drive for the 5763 was obtained from a v.f.o. exciter in this case, and was capacity-coupled through a piece of coax cable to the grid of the 5763. The coax in this case serves only as an additional capacitance across the tank circuit of the exciter. The output of the 5763 is fed through the bandpass coupling network into the grid of the 807's. The input bandpass circuit has a fixed load consisting of the grid leak resistance and the input resistance of the tube when it is being driven. With the load thus presented, the bandwidth is approximately 4.5 megacycles wide. For this reason it is fairly easy to adjust the grid circuit. Even with this wide bandwidth plenty of drive is available for the 807 grids.

The output circuit of the 807's is similar electrically to the grid circuit, however mechanically it is quite different. In the grid circuit, variation in coupling between the primary and secondary tuned circuits is accomplished by varying the position of the link between the two circuits. In the plate circuit this variation is accomplished by orienting the position of the secondary coil with respect to the primary coil. Also, because of the lower power in the grid circuit it was convenient to use slug-tuned coil forms for tuning the primary and secondary. The higher power involved in the plate circuit necessitated the use of variable capacitors for tuning.

The output circuit also involves one more variable to be adjusted, *i.e.*, the antenna loading. In the grid circuit the loading is fixed as stated previously. However in the output circuit efficiency and, consequently, bandwidth is quite important. Thus besides the primary and secondary tuning adjustments and the coupling adjustment, a careful loading adjustment is also necessary.

The load placed on the transmitter must be fairly constant over the whole band. A 300-ohm folded dipole has this characteristic. An ordinary 72-ohm dipole, beam, or other types of relatively low impedance antennas have too high a "*Q*," *i.e.*, too narrow bandwidth to be used satisfactorily with this amplifier.

The antenna must also be cut for the center of the band to present a substantially resistive load to the transmitter over the entire band. This is best done by cutting the antenna longer than necessary for the center frequency (29.1 megacycles). By removing the transmission line from the antenna and making a one-turn loop as shown in Fig. 5, the resonant frequency of the antenna can be quickly determined. By pruning the ends, the exact frequency of 29.1 megacycles can be reached. Unfortunately the dimension cannot reliably be given here because the propagation constant of 300-ohm ribbon varies considerably between different manufacturers. The best and most reliable method is the pruning method described.

The tuning up of the amplifier is done in two stages, first the grid circuit adjustments are completed, and then the plate circuit parameters are adjusted.

The first step in adjusting the grid circuit is to set the resonant frequency of L_1 and L_2. First slide the link L_3 down toward the chassis to loosen the coupling between the primary and secondary. Now adjust the slugs in L_1 and L_2 to 29.1 megacycles with a grid dip meter. Now remove one end of the screen dropping resistor R_{13} so the 807's will not draw any appreciable plate current. Now turn on the plate voltage to the amplifier. Plug a 0-10 milliampere meter in the grid current jack and slide the link up toward the coils. Sweep over a range of approximately 28 to 30 megacycles with the exciter. Adjust the position of the link and touch up the adjustment of L_1 and L_2 to get a fairly constant grid current over the band from 28.5 to 29.7 megacycles. Some juggling of L_1, L_2, and the link position will be necessary since each adjustment interacts with the other adjustments.

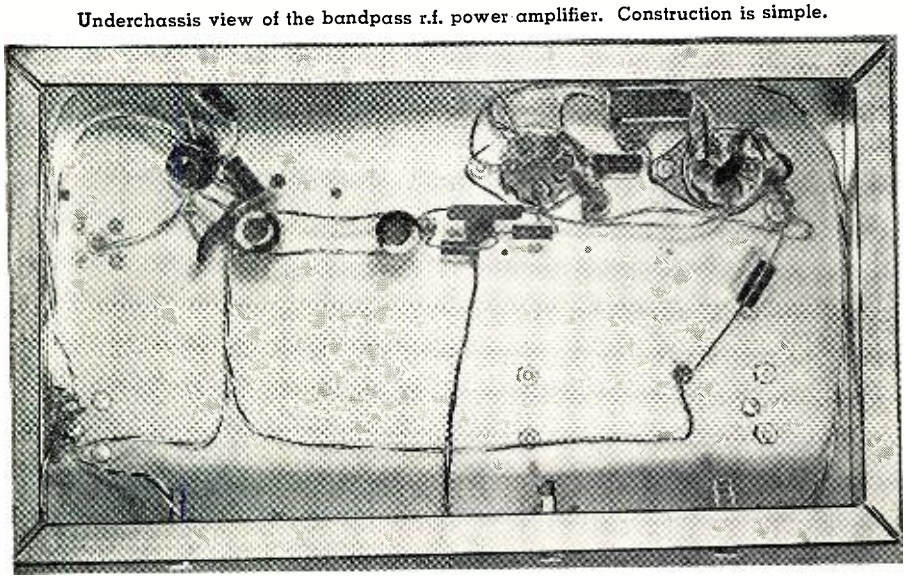
The next step is to adjust the plate circuit. A television sweep generator covering the 28-30 megacycle region and an oscilloscope are very helpful in adjusting the tuning, coupling, and loading adjustments, however they are not essential. A sweep generator and an oscilloscope can give an immediate picture of the condition of the tuning and speeds up the procedure considerably since the effect of any one adjustment can be visually observed on the scope. However since many of us don't have sweep generators and scopes available, an alternative method of tuning will also be discussed.

This latter method, which is not too difficult, uses the amplifiers v.f.o. or an ordinary signal generator that covers the 10-meter band.

The test equipment set up for the sweep generator method is shown in Fig. 1. The 300-ohm resistor simulates the 300-ohm folded dipole for the preliminary adjustments. Set the load tap on the second turn of the secondary coil L_7. Loosen the coupling between the primary coil L_6 and the secondary coil L_7 by rotating the whole capacitor and coil assembly C_{15} and L_7 about the mounting bushing of C_{15}. Set the resonant frequencies of the primary and secondary circuits to 29.1 megacycles by adjusting C_{12} and C_{15} respectively. Now couple the coils approximately as shown in the photographs. Set the sweep generator to sweep through a range of about 25 to 35 megacycles. Adjust C_{12} and C_{15}, the coupling and load tap point to give a flat-topped bandpass of 28.5 to 29.7 megacycles. The adjustment of these four factors

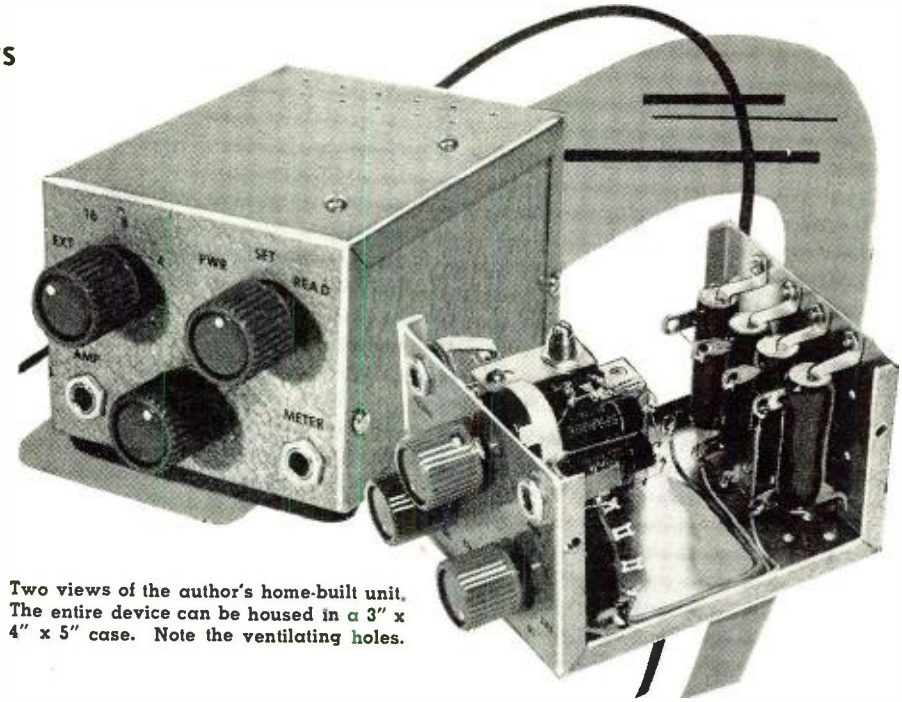
(*Continued on page* 113)

Underchassis view of the bandpass r.f. power amplifier. Construction is simple.



DISTORTION/POWER ADAPTER

By **ALLAN M. FERRES**



Two views of the author's home-built unit. The entire device can be housed in a 3" x 4" x 5" case. Note the ventilating holes.

Construction details on an auxiliary device for checking audio harmonic distortion at full amplifier power output.

HARMONIC distortion and power output can be measured with an a.c. vacuum-tube voltmeter, such as the *Heathkit* AV-2, by the addition of a simple, low-cost adapter. These measurements will aid the service technician and experimenter in his work with audio equipment.

The adapter consists of dummy load resistors of 4, 8, and 16 ohms, a 400-cycle filter, and a meter-set control. The readily available parts are enclosed in a 3"x4"x5" grey hammertone finish aluminum case. No calibration of the unit is required. Its low cost, simple construction, and small size make it a worthwhile addition to any electronic tool kit or workshop.

To determine power output, a steady tone is fed into the amplifier, and the voltage appearing across a dummy load resistance is applied to the formula: "power equals the square of the voltage divided by the resistance." As Table 1 lists the values usually encountered in audio amplifiers, power can be read directly from this table without resorting to any pencil and paper work.

The principle behind the distortion measurements is equally simple. A 400-cycle tone is fed into the amplifier at a sufficient level to produce the output power desired for the measurement. A filter rejects the 400 cycles from the output and the residual voltage is measured by the meter. This residual voltage is the harmonics of the 400-cycle tone which are generated by the amplifier. As these harmonics were not present in the test tone, but produced by the amplifier, they are, therefore, distortion voltages. The percentage of harmonic distortion is the voltage at the output of the filter divided by the voltage at the input of the filter, multipled by 100.

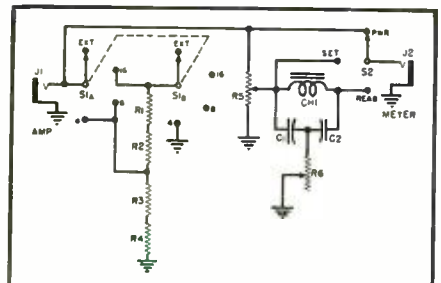
The meter-set control is provided so that the percentage of distortion can be read directly from the meter scale without requiring calculations.

In the schematic diagram, the two-section, four-position, shorting-type switch, S_1, selects the dummy load resistors which are connected to the output of the amplifier under test. As 4, 8. and 16-ohm resistors of adequate power rating are not readily available, two 3-ohm and two 5-ohm, 25-watt units are used. With S_1 in the 16-ohm position, the four resistors are connected in series. For 8 ohms, a 3-ohm and a 5-ohm are connected in series. The 4-ohm load is obtained by a series-parallel connection. A fourth position of the switch, marked "Ext," is provided so that an external load resistor can be connected across the amplifier output if required. As shown in the photographs, ventilating holes are drilled in the back, top, and bottom of the case near the resistors to reduce their temperature rise.

R_5, a 1000-ohm pot, is the meter-set control and is mounted on the front panel. The 400-cycle rejection filter is made up of CH_1, C_1, and C_2, and the balancing control R_6. An *IRC* type RQ11-121 pot, having a very short screwdriver slot shaft, is used for the balancing control. It is mounted under the choke by a flat bracket and a 2¼" length of brass rod, threaded for a #6 screw. A hole is drilled in the bottom of the case directly under the control shaft so that it can be adjusted with a screwdriver when the case is closed. S_2 is a single-section, three-position, non-shorting rotary switch used to connect the meter jack, J_2, across either the amplifier jack, the input of the filter, or the output of the filter.

(*Continued on page 124*)

Complete schematic and parts list covering the distortion/power adapter. It was designed to be used with Heathkit AV-2.



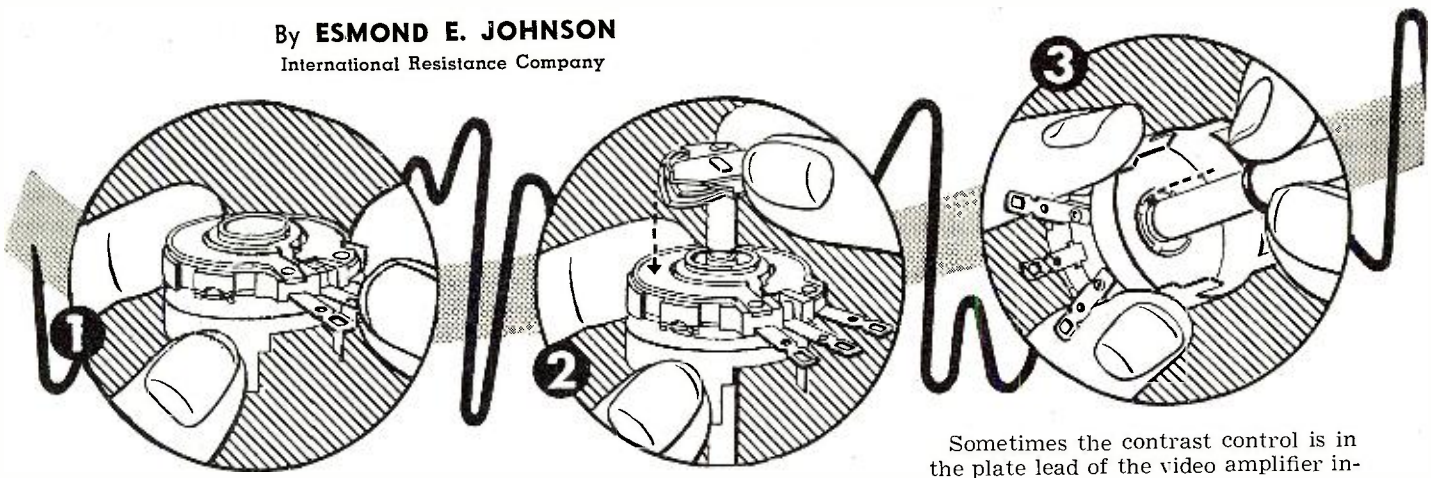
R_1, R_3—3 ohm. 25 w. wirewound res.
R_2, R_4—5 ohm. 25 w. wirewound res.
R_5—1000 ohm wirewound, linear taper pot
R_6—30,000 ohm linear taper pot
C_1, C_2—.068 µfd., 400 v. capacitor
CH_1—3.5 hy., 50 ma. choke (Stancor C-1080)
J_1, J_2—Open-circuit jack
S_1—D.p. 4-pos. wafer switch. shorting type
S_2—S.p. 3-pos. wafer switch, non-shorting type

Table 1. Voltages across load resistances as a function of power ($E = \sqrt{WR}$).

POWER (watts)	LOAD RESISTANCE (ohms) 4	8	16
1	2.	2.83	4.
2	2.83	4.	5.66
3	3.46	4.9	6.93
4	4.	5.66	8.
5	4.47	6.32	8.94
6	4.9	6.93	9.8
7	5.29	7.48	10.6
8	5.66	8.	11.3
9	6.	8.49	12.
10	6.32	8.94	12.6
11	6.63	9.38	13.3
12	6.93	9.8	13.9
13	7.21	10.2	14.4
14	7.48	10.6	15.
15	7.75	11.	15.5
16	8.	11.3	16.
17	8.25	11.7	16.5
18	8.49	12.	17.
19	8.72	12.3	17.4
20	8.94	12.6	17.9
21	9.17	13.	18.3
22	9.38	13.3	18.8
23	9.59	13.6	19.2
24	9.8	13.9	19.6
25	10.	14.1	20.

CONTROLS FOR YOUR TV RECEIVER

By **ESMOND E. JOHNSON**
International Resistance Company



Part 2. How the various types of controls are used in typical TV sets, and the data you need to replace them.

IN LAST month's article, taper, power rating, and some other general characteristics of controls used in TV sets were discussed. The article ended with information on types of controls used in TV audio circuits and gave general replacement data for them.

This article will describe the controls used in the other sections of the typical television receiver. Before we do, however, there is one additional control that is often found in the audio section of TV sets. This is the ratio-detector balance control and it is used to compensate for any unbalance in components in the ratio-detector circuit to give better AM rejection and reduce intercarrier buzz. This control requires negligible power dissipation, making mechanical and taper requirements the only things to check.

TV sets using a 6BN6 gated-beam detector often have an AM rejection control which adjusts the bias of the 6BN6 to cause its operation to take place on the correct portion of its characteristic curve. This control is usually a small 1-watt wirewound type of special construction that can only be obtained directly from the manufacturer.

Video Section

The following controls can be found in the video section of a typical television receiver: automatic gain control level (a.g.c.), brightness control (also called background, brilliance, or shading), contrast or picture control, and in addition, a local-distant control.

The function of the a.g.c. level control is to adjust the operating point of the a.g.c. rectifier for the signal strength that is being received. For very weak signals, the control should be adjusted to give the least effect; for very strong signals, just the opposite is true. Since this control dissipates negligible power, the only requirement for a replacement is mechanical construction, proper resistance, and taper.

Sometimes, this control varies the bias on the a.g.c. keying tube, changing the signal level at which this tube operates. When used in this way, its taper is linear and the control dissipates negligible power.

The brightness control adjusts the bias voltage between the cathode and the control grid of the picture tube to obtain the correct blanking or black level. In other words, this control is adjusted to the point where no vertical retrace lines are visible. Such controls are usually about 100,000 ohms and have approximately 100 volts across the element. This means that the control must dissipate about .1 watt (voltage squared divided by the resistance). This dissipation would be at an ambient temperature (operating temperature of air surrounding control) of about 60 degrees centigrade (140 degrees Fahrenheit) instead of 40 degrees centigrade (104 degrees Fahrenheit) where a .1 watt control would be rated. Therefore, a control rated from ¼ to ½ watt would be satisfactory for this application. A linear taper is usually employed in this circuit.

The contrast or picture control adjusts the bias of the video output tube, thus controlling its gain. The current flowing through this control is approximately 10 milliamperes and its total resistance is usually 1000 ohms. Assuming that this current flowed through the entire 1000 ohms of the control, the power requirements would be .1 watt (current squared multiplied by resistance). However, the actual power dissipated is much less since the current decreases as the resistance in the control increases. This means that a ¼- to ½-watt control would be a very safe replacement. The taper of this control may be R.H. (right-hand) log for smoother operation.

Sometimes the contrast control is in the plate lead of the video amplifier instead of the cathode lead. Frequently, this control is provided with two taps to which frequency compensating networks can be connected to give correct video response at different settings.

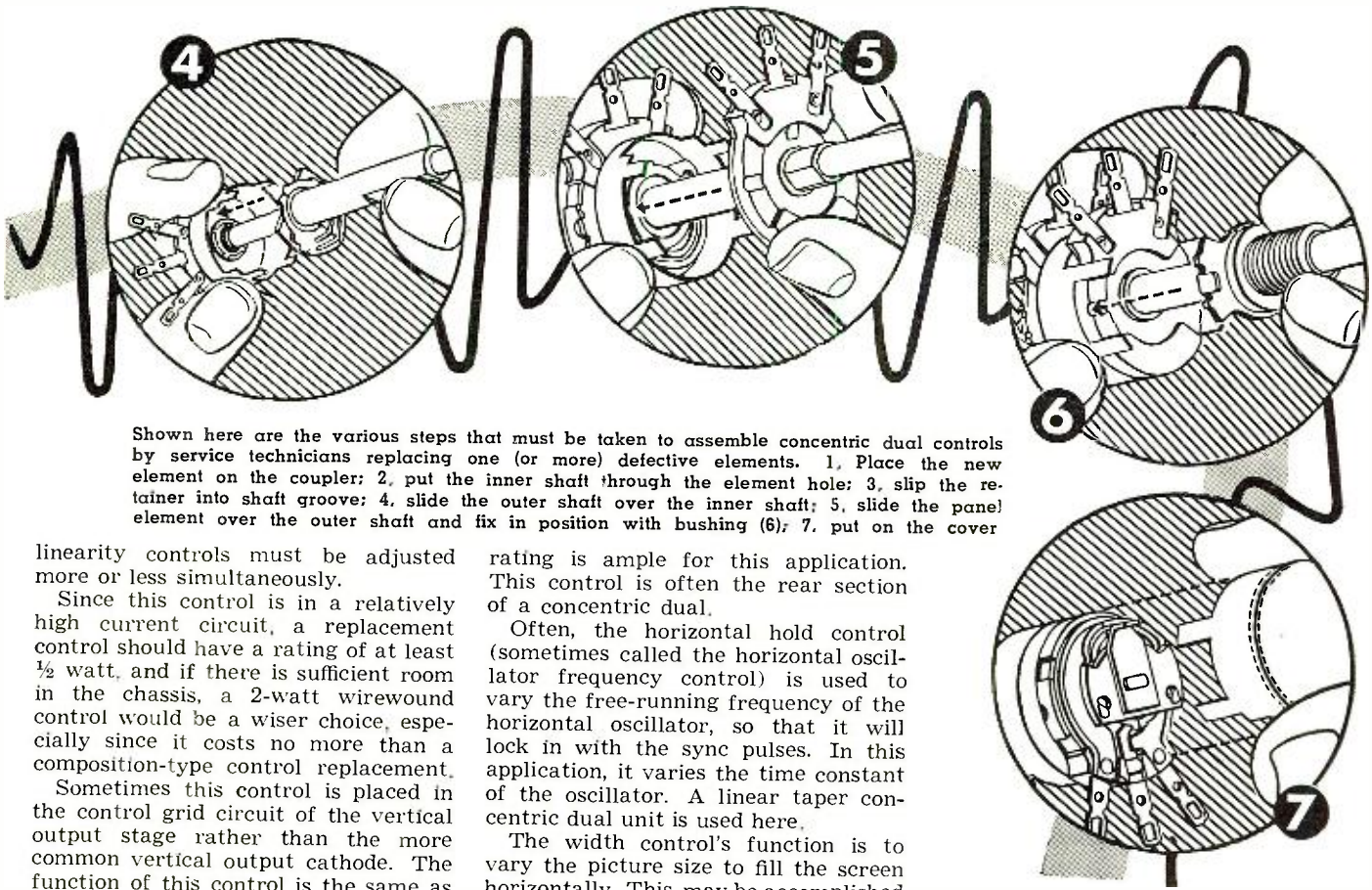
Vertical Sweep Section

In this section we generally find the following controls: height, vertical hold, and vertical linearity. Some sets have a vertical peaking control and, if we consider the sync separator circuits of some modern receivers as being part of the vertical sweep circuit, we have a new control known as the noise inverter control.

The height control is intended to adjust the picture so that it will fill the screen vertically. Generally, this control is in series with the plate of the vertical oscillator. Consequently, as the voltage on the plate is increased by decreasing the height control resistance, the output of the oscillator is increased, thus increasing the height of the picture. Any standard ½- or ¼-watt control would have ample safety factor and would make a satisfactory replacement if it has a linear taper.

The vertical hold control adjusts the free-running frequency of the vertical oscillator so that it will keep in step with the transmitted vertical sync pulses. This is done by varying the time constant of the oscillatory circuit. This control operates at a very low voltage and a ¼-watt control would be ample. The taper of this control is linear. This control generally forms the panel section of a concentric dual-type control which can either be obtained as an exact duplicate from a radio-parts dealer or assembled from parts which he has in stock.

To make the upper and lower half of the picture symmetrical, the vertical linearity control varies the bias on the vertical output tube so as to shift the tube's characteristic to a point where the sweep will be more linear. This also changes the gain of the output stage which, in turn, will affect the height. Consequently, the height and vertical



Shown here are the various steps that must be taken to assemble concentric dual controls by service technicians replacing one (or more) defective elements. 1, Place the new element on the coupler; 2, put the inner shaft through the element hole; 3, slip the retainer into shaft groove; 4, slide the outer shaft over the inner shaft; 5, slide the panel element over the outer shaft and fix in position with bushing (6); 7, put on the cover

linearity controls must be adjusted more or less simultaneously.

Since this control is in a relatively high current circuit, a replacement control should have a rating of at least ½ watt, and if there is sufficient room in the chassis, a 2-watt wirewound control would be a wiser choice, especially since it costs no more than a composition-type control replacement.

Sometimes this control is placed in the control grid circuit of the vertical output stage rather than the more common vertical output cathode. The function of this control is the same as before, but signal bias is used instead of cathode bias to cause the tube to operate on the most linear portion of its characteristic. A control of ¼- to ½-watt rating that meets mechanical and electrical specifications makes a good replacement. The taper of this control is linear.

The noise inverter control is used in a relatively new circuit which cancels out noise effects on synchronizing circuits by amplifying the noise pulses and feeding these amplified pulses back in opposite phase to the sync separator circuit, thus cancelling out any effects of noise. Any noise pulse that remains is in the negative region opposite the sync pulses and can cause no harm. The purpose of this control is to adjust for the noise condition of any particular locality. A control rated at ½ watt and meeting mechanical and electrical requirements makes a satisfactory replacement. The taper of this control is linear.

Horizontal Sweep and High Voltage

In this section we have the horizontal hold, horizontal oscillator frequency, horizontal drive, and width controls. Another control that could be placed in this section is the electrostatic focus control for either high voltage or low voltage focus requirements.

Most times the horizontal hold control varies the voltage supplied to the plate of the a.f.c. tube to provide correct reactance to hold the oscillator in step with the transmitted sync pulses. A control of ¼- or ½-watt rating is ample for this application. This control is often the rear section of a concentric dual.

Often, the horizontal hold control (sometimes called the horizontal oscillator frequency control) is used to vary the free-running frequency of the horizontal oscillator, so that it will lock in with the sync pulses. In this application, it varies the time constant of the oscillator. A linear taper concentric dual unit is used here.

The width control's function is to vary the picture size to fill the screen horizontally. This may be accomplished by varying the screen voltage of the horizontal output tube, thus increasing or decreasing its gain which, in turn, increases the horizontal sweep or width. Even though this control (when used on such a circuit) only dissipates approximately 1 watt, a 4-watt control is required to obtain the required resistance. Any good 4-watt control with linear taper, correct size, and resistance, will make a satisfactory replacement. (We are not here concerned with width controls which are adjustable coils.)

The horizontal drive control under normal operating conditions has about 35 volts across half of its resistance which would require a control of about ¼-watt rating. To take care of ambient temperature conditions and have a good safety factor, a ½-watt control should be used.

The focus control varies the sharpness of the electron beam to give a clean, clear picture without blur by increasing or decreasing the voltage applied to this picture-tube element. The voltage across this control is frequently the boosted "B+" which is about 500 volts. This would require a control of approximately .1-watt rating. Any good ½-watt rated control that will meet voltage breakdown, mechanical, and electrical specifications will be a satisfactory replacement. The taper is linear.

Low-Voltage Power Supply

The magnetic focus, horizontal centering, and vertical centering controls are found in this section.

Magnetic focusing sharpens the picture by varying the current through the focus coil to produce as small a beam spot as possible on the face of the picture tube. The rating of this control generally is about 4 watts, even though it actually may have only 35 volts across its terminals, which would make it dissipate approximately .6 watt. (The total resistance of the control is about 2250 ohms.) This, however, is not quite the case since, in one typical circuit, approximately .04 ampere is drawn through the contactor with a 5-volt drop in the control. At this setting, then, the control is at 125 ohms—1/18 of its total resistance. The power in this section of the control would be 5 volts multiplied by .04 ampere, giving .2 watt. For the whole control, therefore, a wattage of .2 times 18 or 3.6 watts is required.

The horizontal centering control places the picture in the center of the mask horizontally. This control is a 2-watt wirewound type with a linear taper, as is the vertical centering control.

This article has only scratched the surface on the various TV circuits in which controls are used. By the time this article is published, many new control requirements will have been created. This is especially true of color television, which uses many more controls with varied requirements. However, in all cases, the right taper, how to find it, and the power rating of the control are the factors the service technician must know to achieve quick and successful control replacement and TV set adjustment. —30—

ALL-CHANNEL ALL-WAVE ANTENNA

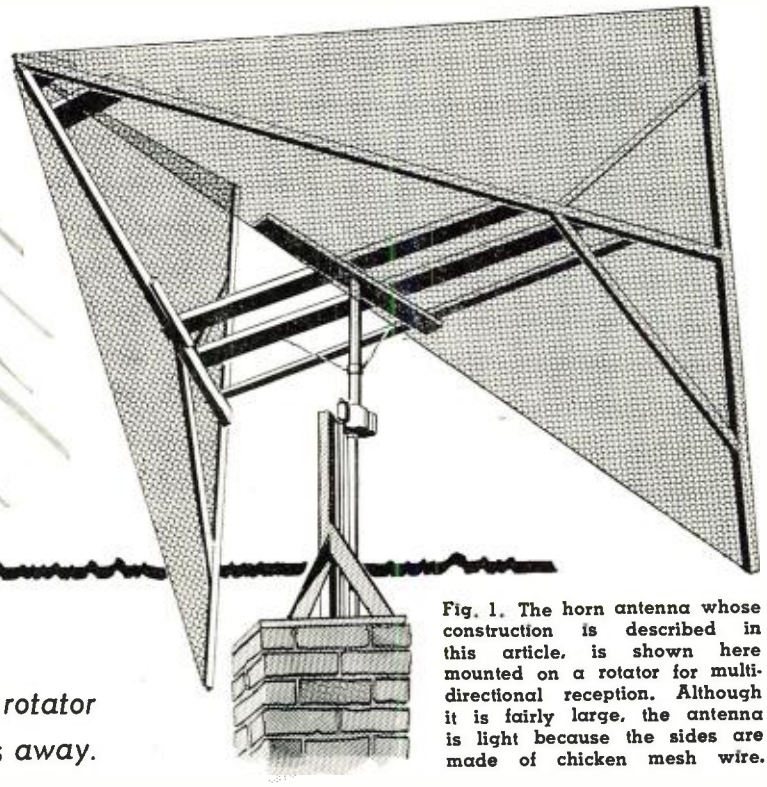


Fig. 1. The horn antenna whose construction is described in this article, is shown here mounted on a rotator for multi-directional reception. Although it is fairly large, the antenna is light because the sides are made of chicken mesh wire.

By **JOSEPH MARSHALL**

Use this antenna with or without a rotator to pull-in TV channels over 200 miles away.

ONE of the most vexing problems in fringe area TV reception is that of obtaining multi-channel reception. Where only one or two stations are within reliable range, separate antennas for each channel is the ideal solution. However, where a location is within range of a number of stations both on the high and the low band, separate antennas become impractical.

It is true that there are a number of antennas which provide fair multi-channel or all-channel reception. Among these are the stacked conicals, modified yagis, and colinear arrays with reflectors. The trouble is that, being resonant, most of these arrays provide optimum pickup on only a few channels and optimum impedance match on even fewer and, unless some form of tunable matching network is used, they fail to deliver optimum gain. Moreover, their directional characteristics vary from channel to channel. They work well in the near-fringe areas but seldom live up to expectations in the far fringe.

The nonresonant, transmission-line rhombic antenna provides excellent gain on most of the channels and, being nonresonant, does not suffer mismatch losses from channel to channel. However, for appreciable gain on the low bands, a rhombic needs to be at least 40 feet long. Where all the stations lie in the same direction, a fixed rhombic provides an excellent solution; but since it is virtually impossible to rotate a rhombic 40 feet long, it is not suitable for reception from several directions.

Horn antennas have found great use in the microwave bands, notably in radio-relay systems, but they are not easily applicable to the v.h.f. TV frequencies because of their bulk, weight, wind resistance, and the problem of transferring the signal from horn to feedline. However, some modifications on the conventional horn antenna, introduced by Dean O. Morgan of *G-E*, makes this antenna practicable for use on the TV frequencies. The first and most obvious was that of using wire instead of solid metal for the horn sides. The second was that of eliminating two sides of the horn. Since TV signals are horizontally polarized, only the two vertical sides of the horn are necessary. Finally, for a two-sided horn, the feedline could be connected to the two apexes. The result is an antenna which, although bulky, has extremely high gain, broad bandwidth, is capable of being rotated, and presents a nearly uniform impedance over a great frequency range.

Although the location at which the antenna shown in Fig. 1 is erected is 140 airline miles from Atlanta, Georgia —some 20 calculated miles beyond line of sight—phenomenally good reception is obtained on channels 2 and 5 in Atlanta. Channel 8, which could not be received with any degree of dependability despite considerable effort, has been brought in by the horn antenna where all others failed. Unlike most antennas, the horn apparently delivers in practice the theoretically determined performance. Moreover, it proved to be completely non-critical in construction, adjustment, and erection. Its performance is really phenomenal and very much worth the small trouble involved in its construction.

Fig. 2. Graph of relative gain of the horn antenna over its frequency range.

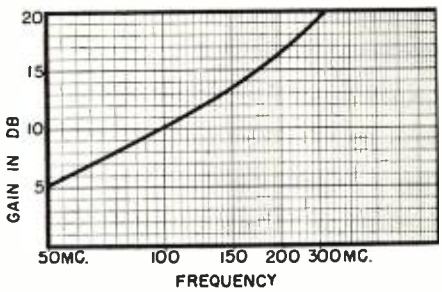


Fig. 2 gives the calculated gain of an 11-foot horn (mouth size) over that of a resonant folded dipole at each frequency. It will be seen that it provides almost 6 db gain on channel 2, over 9 db on channel 6, and between 15 and 17 db on the high v.h.f. band channels, as well as 10 db in the FM band. The impedance is 450 ohms on channel 2 and 400 ohms above that. Experience indicates that the theoretical gain is actually achieved in practice. In other words, the horn provides a gain equal to or exceeding that of most stacked commercial yagis on channels 4, 5, and 6; equal to that of a single commercial yagi on channels 2 and 3; and twice the *voltage* gain (or 4 times the power gain) of stacked yagis on channels 7 to 13.

Where channel 5 suffers from interference from an FM station, as it does in the author's neighborhood, use of a narrow-band yagi for that channel alone will reduce the interference. Channel 4 in Birmingham, Alabama, 200 airline miles distant, can be received almost constantly, and so can channel 3 in Charlotte, North Carolina, 225 miles away over the mountains. Sporadic reception of other stations has been experienced on almost every channel.

When the FM receiver was connected to the antenna, stations began to pop out of the noise all over the dial. Every FM station in Atlanta, even the

low-powered ones, is now received with full quieting almost 100 per-cent of the time. The receiver is extremely sensitive, to be sure, but nevertheless, only the three most powerful stations had ever been logged previously.

Finally, the antenna works more than adequately on the short-wave and broadcast bands with an "SX32" receiver. This, despite the fact that the antenna ceases to operate efficiently as a horn when its sides are smaller than one-half wavelength at the signal frequency received. Under these conditions, it becomes a very large, broadband conical dipole. The 11-foot antenna shown in Fig. 1 is resonant at about 20 mc. and gives good performance from about 13 to 40 mc. Below this, and especially at broadcast frequencies, it operates simply as a large pick-up sheet, and because of its area, absorbs a considerable amount of energy. It is not, of course, very directional below 30 mc. The antenna is, in effect, a single all-wave, all-channel radio and TV antenna, which is simply switched from TV to FM and AM receivers.

The results are all the more striking because the cost is very low and the construction simple. Fig. 3 gives the dimensions of an 11-foot horn. This is about 1 wavelength on channel 6 and was chosen because the necessary wood strips can be cut from a single 12-foot board, whereas longer boards are hard to find.

The four main wood strips are 1½ inches wide and ¾ or ⅞ inch thick. The various braces can be 1 inch wide, and the horizontal joining pieces should be about 4 inches wide. The two wire-covered triangles which form the sides are assembled first. Joints are made with 2½- and 3½-inch carriage bolts. The long cross pieces are drilled to take the horizontal boards, so that the horn can be assembled easily by setting and tightening bolts.

The wire for each triangular side can be cut from one 14-foot length of chicken wire, 5 feet high. The two triangles are assembled into the horn by bolting the cross pieces in place. Two vertical braces can be nailed at the mouth to keep the horn from twisting. The mast is mounted at the point of balance, which can be determined experimentally by moving the mount back and forth between or under the cross pieces until the point is found at which the antenna will balance itself horizontally. If a broad-based mast mount is used, no strutting or bracing is necessary.

Fig. 5 is a universal design chart for horns of various mouth sizes with a flare angle of 50 degrees. This is an excellent compromise angle; narrow enough to give sharp directivity and not so broad as to offer maximum resistance to the wind. Fig. 4 is a universal gain chart for a 50-degree horn. It will be noted that, whereas in ordinary antenna arrays the power gain doubles as the antenna size is doubled, in the horn antenna, the power gain is quadrupled as the antenna size doubles. The chart shows that a gain

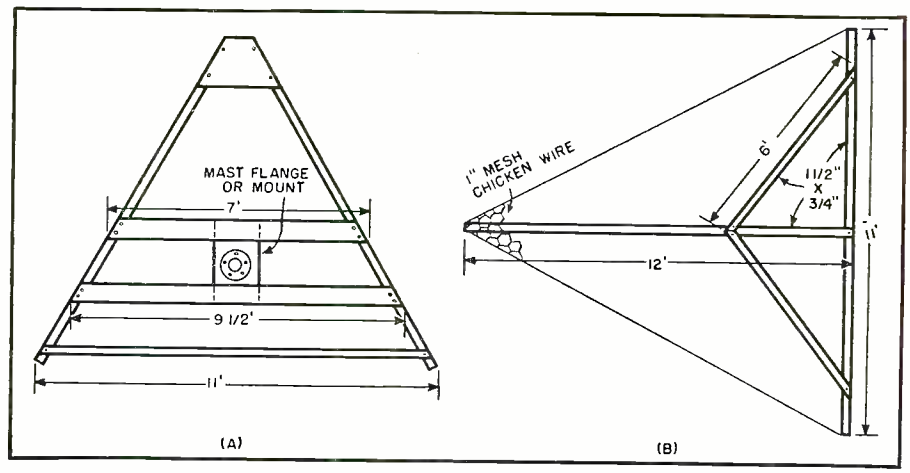


Fig. 3. Dimensions of the horn antenna designed for channel 6. (A) is the top view of the antenna structure, (B) is the side view for one of its sides.

of 20 db can be achieved with a horn 3½ wavelengths wide at the mouth.

For vertically polarized signals, the horn can be turned so that the sides lie in the horizontal plane.

To use the design chart in Fig. 5, hold a straightedge joining the equal numbers on the lines *AA* and *A'A'*, which represent the desired mouth width and height. The point where the straightedge intersects the diagonal line *B* gives the length of the strip *B* in each side of the triangular sides. Thus, for instance, for a horn with a mouth 11 feet wide, the strip *B* is just a little over 12 feet long.

The antenna dimensions to suit your particular situation depend, of course, on the stations you desire to receive. It is best to cut the antenna for the center of the frequency range you are interested in. For TV, for example, channels 2 to 4 cover the frequencies from 54 to 72 mc.; channels 5 to 6, 76 through 88 mc.; channels 7 through 13, 174 to 216 mc., and channels 14 through 83 cover 470 to 890 mc. For channel 10, therefore, the lower frequency limit is 174 plus 18, or 192 mc. (Each channel is 6 mc. wide.) The wavelength you need is that of the video carrier, which is 1.25 mc. added to the lower frequency limit of the channel. For channel 10, the wavelength is 984 divided by (192 + 1.25) or 5 feet.

There is plenty of room for improved mechanical engineering, al-

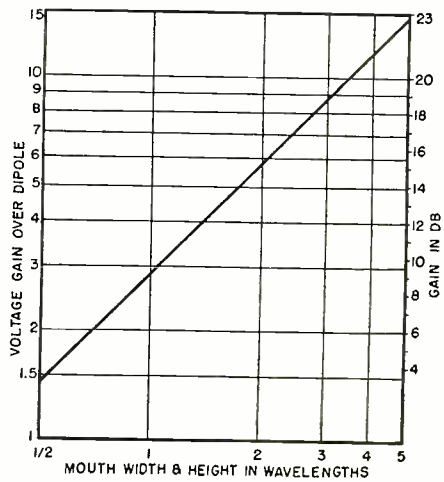
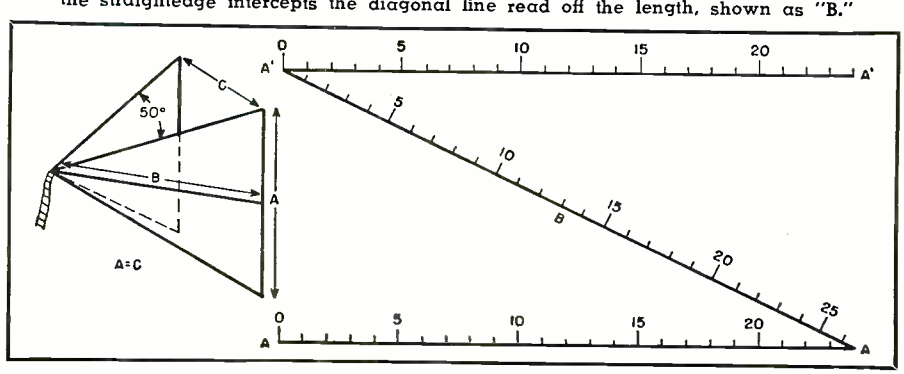


Fig. 4. Graph of antenna voltage gain for various horn antenna mouth widths.

though the model shown here has withstood winds of about 40 miles per hour. For instance, the booms could be made of aluminum tubing and the sides of wire or small-diameter tubing splines, as is done in corner reflectors. An all-metal design, however, would require that the horizontal cross pieces which form the two sides into a horn be insulated from each side.

The transmission line to the receiver is connected at the apex of the horn, one wire to the end of each triangle. Any good low-loss transmission line can be used. —30—

Fig. 5. Nomograph for determining the length of the horn antenna sides, knowing the height and width (which are the same). To use, place a straightedge from the top line to the bottom line at the dimension chosen for the height, where the straightedge intercepts the diagonal line read off the length, shown as "B."



By **BERT WHYTE**

THIS department is published each month as a service to the readers of RADIO & TELEVISION NEWS. As such, it is my duty to try and satisfy the wants and wishes of the readers. The only way in which I am aware of your ideas and your wishes is through your letters. Naturally, it is quite impossible to satisfy each individual, so as far as I'm concerned—the majority rules. When a large percentage of you indicate a desire for some change or new procedure in my conduct of this column—if the suggestion is within the realm of practicability—I'll do my darnedest to comply. The foregoing has been necessitated by a goodly number of letters from you nice people, asking for more reviews and more coverage. I'm flattered and grateful that more of my yak-yak is wanted, but I must admit this request has more than the usual number of problems. As always, the main bugaboo is space.

In a large circulation magazine like this one, space is all-important, and with many departments and articles vying with each other, such an animal as "extra space" is virtually non-existent! Some space can always be picked up by reducing the type face. This has already been done once with this department and I don't think any further reduction is practical. After all, I don't want you to squint yourself blind!

I have given much thought to this problem and have come to the reluctant conclusion that the only possible alternative is to reduce the length of the reviews. I don't like this idea at all. I feel that the "nice music-fine recording" type of review is just short of an insult to the record company and artists involved and is a disservice to the reader. Yet, your letters indicate that you want more coverage so I can't ignore this situation. Therefore, as an experiment this month, the reviews will generally be much shorter than is usual. I positively refuse to get to the point where the review will be little more than a "listing". I will still endeavour to give information about the record's place in the catalogue, the music, the artists and orchestras involved, the performance and the sound quality. If this information can be encompassed in a smaller space, then obviously more coverage will be possible. I'll give this idea a whirl this month and then I'll await your reaction. Please write and give me your opinions in this matter. If a majority of you like the format and the shorter reviews, they will be continued. If not, I will return to my "standard" format and hope that some day more space will be available.

Equipment used this month: *Fairchild* arm and cartridge, *Components Corporation* turntable, *Marantz* audio consolette, *H. H. Scott* 70-watt amplifier, *Jensen* "Imperial" system, *Electro-Voice* "Georgian".

The opinions expressed in this column are those of the reviewer and do not necessarily reflect the views or opinions of the editors or the publisher of this magazine.

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(CHURCH WINDOWS)
Minneapolis Symphony Orchestra conducted by Antal Dorati. Mercury "Olympian" MG50046. RIAA curve. Price $4.98.

Without much doubt, this is the loudest recording ever made! As a strictly sonic experience this is astounding. As a musical experience, the total effect is overwhelming. Not since the same conductor's notable reading of Stravinsky's "Le Sacre", has there been anything like this! "Feste Romane" receives here its third recording and competition crumbles before it . . . neither the Toscanini nor Ormandy recording can stand comparison. The Ormandy we can dismiss as badly outdated. The Toscanini version was blessed with some pretty good sound considering its age and other factors, but good as it was, it pales before the sheer magnificence of this effort.

From the opening stentorian blasts of trumpet and trombone, the thunder of tympani and bass drum, the coruscating clash of cymbals, and the head-splitting crash of great gongs, to the tinkling of tiny bells and the delicate tracery of the mandolin solo in the "October Festival" section and the frenetic trumpets, mocking trombones and myriad percussives of the "Epiphany", this is a sonic *tour de force* that is unlikely to be equalled for many a year!

Toscanini's reading was almost frantic in its intensity and he conducted at tempi which were almost unplayable. Dorati uses more directed energy, his tempi a little slower as he strives for a cleaner delineation of the complex score.

"Church Windows" has its premiere on LP on the flip side of the record and while generally in a quieter mood has passages which, if anything, are even louder and more awe-inspiring than the "Feste"! Particularly is this true of the section called "St. Michael the Archangel" and "St. Gregory the Great". Here we have the stunning roar of 32-foot organ pedals along with the blast of massed brass, the impact of bass drum and tympani and at the conclusion of the "Archangel" one of the most tremendous gong crashes ever recorded! This is really fantastic . . . after the initial transient impact, the reverb of the undamped gong is heard for at least 15 to 20 seconds.

Throughout both works the sound is ultra-wide-range and with dynamics which are not quite believeable. The vast climaxes are wondrously distortion-free, practically no pre- or post-echo is present and the acoustic perspective is quite unusual in its balance of "liveness" and superb inner detail. In fact, I understand this recording represents a modification of the famous "Olympian" technique, in which instrument definition and orchestral textures are imbued with still more "living presence". Whatever the engineers did, this represents just about the present pinnacle of the recording art. No audiophile worthy of the name can afford to be without this recording!

MILHAUD
CONCERTO FOR PERCUSSION AND SMALL ORCHESTRA
CHAVEZ
TOCCATA FOR PERCUSSION
BARTOK
MUSIC FOR STRINGS, PERCUSSION, AND CELESTA
Capitol P8299. RIAA curve. Price $4.98.

Here is another "must" for the hi-fi fan! If this doesn't give you your fill of transients and percussives, you may as well go to work in a boiler factory. Yessir, you name the percussion instrument and you'll find it employed in one of these works. Felix Slatkin conducts his virtuoso Concert Arts Orchestra in the Milhaud work. If your speaker sounds like it's making some strident sound during this piece, don't get alarmed. The scoring is such that such notions are inevitable. Most women won't care for this at all! The Chavez work was reviewed last month as part of *Capitol's* new "High Fidelity Adventure" album. Only the third movement was on that disc and the two preceding movements here recorded are equally interesting and full of the bing and the bang. The Bartok is a re-issue of the old ten-inch album brought up to date by new processing and sounds better than ever. The Kubelik-*Mercury* reading is the better sound version of this work, but the use of the chamber group here is authentic and may be preferred by purists. A very good recording throughout, quite wide in range and with superb dynamics. The Concert Arts percussionists do the good work in the Chavez ably directed by Felix Slatkin and Harold Byrns and the Los Angeles Chamber Symphony show their competence in the Bartok work. No curve adjustment was necessary. Quiet surfaces in my copy.

CHORUSES FROM GERMAN OPERA
Chorus and Orchestra of the Stadtische Opera, Berlin, conducted by Hansgeorg Otto. Telefunken TM68031. RIAA curve. Price $2.98.

This little disc has some of the most beautifully balanced choral sound I have ever heard. In the "Entry of the Guests" and the "Pilgrims' Chorus" from Tannhauser you will hear a rich, full-bodied vocal tapestry, an altogether luscious sound. The smoothness of texture and the luminosity have to be heard to be believed. This is the sort of thing *Telefunken* has always excelled in and it is good to see their hand has not lost its skill since the war. From the orchestral standpoint, wait 'til you hear the trumpet fanfare in the opening bars of the "Entry"! Simply fabulous—mostly because of the incredibly live acoustics. The "Huntsman's Chorus" from Der Freischutz and another work receive equally splendid reproduction. The chorus is wonderfully trained and their discipline is fantastic. Don't fail to hear this one!

DEBUSSY
LA MER
IBERIA
NBC Symphony Orchestra conducted by Arturo Toscanini. Victor LM1833. RIAA curve. Price $3.98.

A superb coupling and a superb recording. The "La Mer" is re-issued from a few years ago and has been re-processed with modern

(*Continued on page* 133)

MULTIPLE RECORDING WITH A SINGLE RECORDER

By **JACK THORNTON**

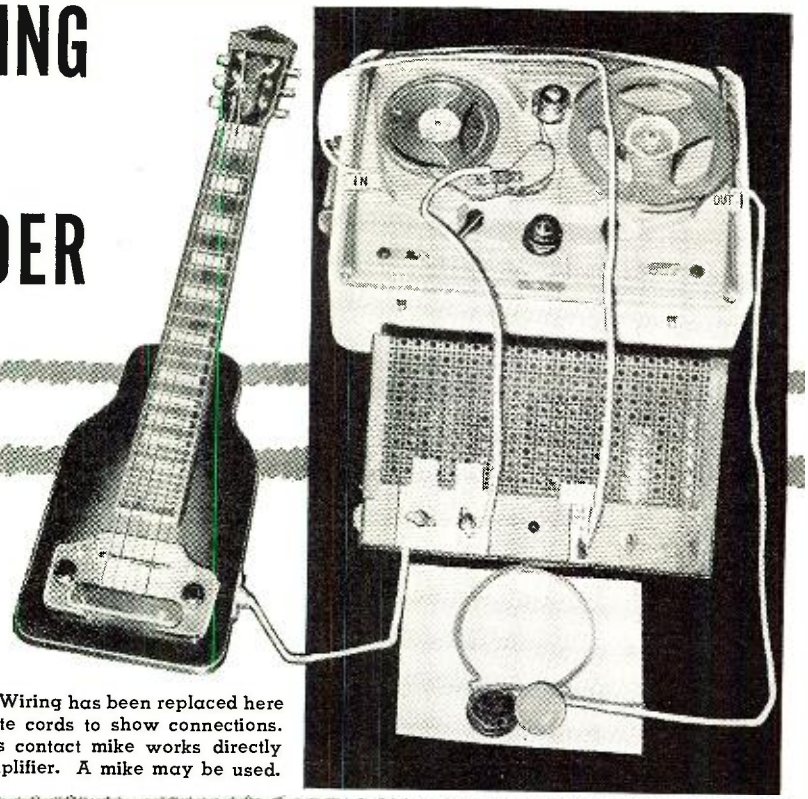


Fig. 1. Wiring has been replaced here by white cords to show connections. Guitar's contact mike works directly into amplifier. A mike may be used.

By simply converting your present tape recorder or by adding another head, you can obtain some novel musical effects on a single tape, using only one tape recorder.

THE post-war years have seen the rise of "gimmick" phonograph recordings utilizing electronic effects. One of the most striking of these is multiple recording. Many persons have admired the one-man bands and single-person quartets created by this technique. But most have felt that such records must require a great deal of equipment. Such is not necessarily the case; multiple recordings can be made with a single tape machine plus an amplifier.

The author's article on artificial echo suggested a novel variation using the same equipment. With it the experimenter can produce interesting musical effects.

The normal procedure in multiple recording is to record, for example, a singer. The record is played back as the singer adds a second part. A second recorder tapes both the original and added parts. This is repeated for as many parts as desired. The two machines operate alternately as recorder and playback. But for the amateur workable results can be obtained with but a single tape recorder.

A reference to the previous article on artificial echo, which appeared in the April issue of this magazine, will show the basic operation of a typical tape recorder. That text dealt with adding an extra playback head *past* the regular head for creating added "liveness" in music and speech. In multiple recording the additional playback pickup must be mounted *ahead* of the erase head. The auxiliary head is mounted somewhere between the supply reel and the erasing head. Distance is not critical as it was in producing echo effects. Fig. 1 shows a typical location.

The additional head on the machine shown in Fig. 1 is clamped down with spring steel held under one of the original-equipment head's mounting screws. If space is available, the extra head may be mounted with wing-bolts through a slot cut in the machine's top surface.

As with the echo setup, choose a high or a low impedance head as required by the microphone input of your amplifier. A firm mounting is required with the tape meeting the working surface of the pickup squarely. There is no advantage here in making the head adjustable in distance from the regular heads. If your machine is one having two or more original record-playback heads it may be possible to remove one of the heads and relocate it ahead of the erase head. (Unplug the machine while working as some erase heads have a high voltage across them whether the machine is running or not!)

Turning attention to the amplifier, wire the extra playback head into a microphone input of the amplifier. The article on echo circuits will offer wiring suggestions. Attach the amplifier's output to the high-level input of the tape machine. This input is marked "radio" on many recorders. Plug a pair of earphones into the tape recorder output. Now, plug a microphone into the amplifier's other mike channel and you're ready to make multiple recordings.

Among the points that should be noted in wiring is that the electrical terminals on the head should be attached by means of shielded wire of the type used to connect a phonograph pickup with its amplifier. On the other end of the wire you can attach a plug which will fit into the amplifier's microphone input. Keep the wire short to avoid unnecessary hum pickup.

Record the first time through in a normal manner, using the microphone through the amplifier into the tape machine. The second time have the musician wear the earphones. Turn up the volume on the amplifier channel which is connected to the extra head. Operate the machine on "record." As the tape passes the auxiliary head the first recording will be picked up and fed through the amplifier to the tape machine. The musician will hear it on the phones and be able to sing or play along with it. The tape recorder will then erase the original recording, but will re-record it along with the added part. Additional parts may be added as skill allows. Each time the previous part or parts will be played back, erased, and re-recorded with the new part added.

On a few machines there is no output which will operate the earphones while the machine is recording. In such cases the headphones are attached to the amplifier output. Some amplifiers may require the addition of a preamplifier between the extra playback head and their microphone inputs, although this should be no problem if the head is selected to match the amplifier input impedance. Whether or not this is required depends solely on your particular equipment.

A little practice will give you the knack of this process and allow you to produce interesting multiple recordings. -30-

TONE TRANSMITTER FOR RADIO CONTROL

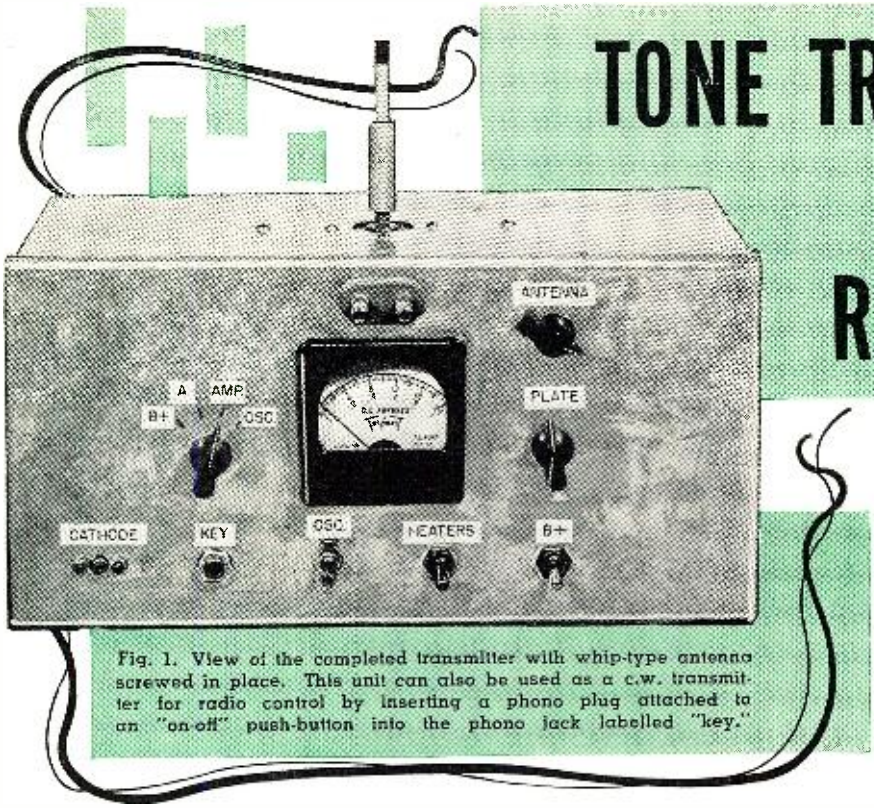


Fig. 1. View of the completed transmitter with whip-type antenna screwed in place. This unit can also be used as a c.w. transmitter for radio control by inserting a phono plug attached to an "on-off" push-button into the phono jack labelled "key."

Here's a transmitter that will give R/C model airplane and boat fans simultaneous control of 3 or more actions.

By **E. L. SAFFORD, Jr.**

THE transmitter to be described here was designed to be used with carrier-operated or tone-operated 27.255-mc. radio-control receivers on the Citizens band. The input required is six volts from an automobile battery, and the output from the transmitter is about three watts.

An exterior view of the completed transmitter is shown in Fig. 1. This unit may be used to control the operation of a model airplane, boat, or racing car, and for various applications around the home or shop.

Refer to Fig. 2. The r.f. section consists of a 6AK6 (V_1) used as a tri-tet oscillator employing a tuned-cathode circuit. The output of the plate circuit is tuned *via* L_2-C_4 to the third harmonic of the crystal frequency. (The third harmonic of a radio-control Citizens band crystal is 27.255 mc.)

The dropping resistor, R_6, is chosen to allow a high enough voltage for proper operation yet not enough to cause crystal damage.

The final amplifier stage (V_2) requires no neutralization because of the internal construction of the 6AK6, provided that there is shielding between the grid and plate circuits. In construction, this is accomplished by building the plate circuit on the top of the chassis and shielding the plate pin with a small brass strip. (See Figs. 3 and 5.) The feed through the chassis is made right at the pin location.

Tuning is accomplished with a three-plate variable capacitor, C_{10}, and a small fixed padder, C_9. This was done to achieve a bandspread type of tuning offering simplicity and accuracy, and to prevent bad mistuning which might damage the final tube.

The antenna is tuned by capacitor C_{13}. This is adjusted to give the desired current reading of fifteen milliamperes with the specified length of antenna in place, and the meter switch, S_6, set to "Amp." Some re-adjustment of C_{10} may be necessary. Tune C_{13} to 15 milliamperes and then adjust C_{10} for a minimum reading. Keep repeating this process until the minimum is the required value.

The audio circuit is composed of a blocking-type oscillator where the size of the grid resistor (R_2, R_3, or R_4) determines the audio output frequency. Three capacitors for low, medium, and high frequencies (C_{16}, C_{17}, C_{18}) are connected from the plate of the oscillator tube to ground to improve the waveform by tuning the transformer.

Since it is necessary to ground both the desired grid resistor and capacitor at the same time, a double-pole, single-throw type push-button switch is used for each tone desired. When all the switches are open, the grid of the 9002 blocks and no tone is generated. The three switches are mounted on a control box that may be carried in the hand.

The size of the grid resistors shown on the schematic will produce tones of approximately 600, 1200, and 2500 cps. However, by making each resistance a two-megohm potentiometer, the tones can be adjusted to any frequency in the particular range covered by the capacitors. Additional tones may be produced by adding more potentiometers and connecting the correct capacitors.

A 6C4 voltage amplifier drives the 6AQ5 stage. The method of modulating the 6AK6 final amplifier by using a push-pull output transformer is simple, economical, and gives one-hundred-per-cent modulation.

The vibrator supply is standard, using a synchronous vibrator to reduce parts and battery drain. A keying jack, J_1, is provided to allow breaking the carrier for use with carrier-operated receivers. With this type of receiver, it is recommended that the 6AQ5 be removed from its socket. No other change is necessary.

Two switches, S_4 and S_5, are provided so that the heaters may be kept hot during standby periods.

The metering circuit allows tuning of the oscillator and final stages by measuring the current to each, and provides two voltmeter positions to give a check on "B+" and the "A" supplies. The shunts, R_5 and R_{10}, are chosen to give a 50-milliampere full-scale reading with an 0-1 milliammeter which has a 27-ohm internal resistance. To find the actual current being drawn, multiply the reading obtained by 50. (For example, 15 milliamperes would read .3, etc.). Resistor R_9 allows a 500-volt full-scale voltage reading (multiply by 500), and R_{10}, a 10-volt full-scale reading.

Construction

Drill the holes in the large chassis (7"x11"x2") and in the front panel (13¼"x6½"), and then bolt the panel to the chassis. Install the meter, meter switch, final capacitor (C_{10}), and antenna capacitor (C_{13}). Next, assemble the V_1 cathode coil, L_1, to C_1 and C_2, and mount on the underside of the chassis as shown in Fig. 4. After installing the oscillator coil, L_2, and its capacitor, C_4, and the keying jack, check with a continuity meter to be certain that none of these parts are grounded to the chassis. When wiring

R_1, R_2, R_{11}, R_{12}—100,000 ohm, ½ w. res.
R_3—1 megohm, ½ w. res.
R_4—780,000 ohm, ½ w. res.
R_5, R_{16}—.47 ohm, 2 w. wirewound res. (IRC Type BW)
R_6—15,000 ohm, ½ w. res.
R_7, R_{13}—470,000 ohm, ½ w. res.
R_8, R_{14}—1000 ohm, 1 w. res.
R_9—500.000 ohm, ½ w. res.
R_{10}, R_{15}—10,000 ohm, ½ w. res.
C_1—100 μμfd. mica capacitor
C_2, C_{13}—140 μμfd. variable capacitor
C_3—.03 μfd. paper capacitor
C_4—25 μμfd. variable capacitor
C_5, C_8, C_{12}—.25 μfd paper capacitor
C_6—100 μμfd. capacitor
C_7, C_{11}—500 μμfd. mica capacitor
C_9—10 μμfd. mica capacitor
C_{10}—25 μμfd. variable capacitor (Reduce to 3 plates)
C_{14}—.001 μfd. paper capacitor
C_{15}, C_{17}, C_{19}—.01 μfd. paper capacitor
C_{16}—.005 μfd. paper capacitor
C_{18}—.05 μfd. paper capacitor
C_{20}—25 μfd., 25 v. elec. capacitor
C_{21}, C_{22}—10 μfd., 450 v. elec. capacitor
C_{23}—.1 μfd., 600 v. paper capacitor
C_{24}—.005 μfd., 1600 v. paper capacitor
C_{25}—.5 μfd. paper capacitor
CH_1—10 hy., 50 ma. choke
J_1—Shorting jack, normally closed
L_1—13 t., #16 airwound, ⅝" dia. spaced ½ dia. of wire
L_2—11 t., #16 airwound, ⅝" dia. spaced dia. of wire; tap 3 t. from plate end
L_3—11 t. "Miniductor" #3015
L_4—2 t. hook-up wire closewound around cold end of L_3
M_1—0-1 milliammeter
RFC_1—2.5 mhy. r.f. choke
RFC_2—44 μhy., 7-35 mc. r.f. choke (Ohmite Z-14 or equivalent)
S_1, S_2, S_3—D.p.s.t. push-button normally open, leaf switch
S_4, S_5—S.p.s.t. toggle switch
S_6—D.p., 5 pos. non-shorting rotary switch
T_1, T_2—Output trans., 4000 ohms to v.c. (Triad S-53X)
T_3—Vibrator trans., 260 v. d.c. at 60 ma. (Merit P2972)
Xtal.—27.255 mc. crystal
1—Vibrator, 6-volt synchronous
V_1, V_2—6AK6 tube
V_3—9002 tube
V_4—6C4 tube
V_5—6AQ5 tube

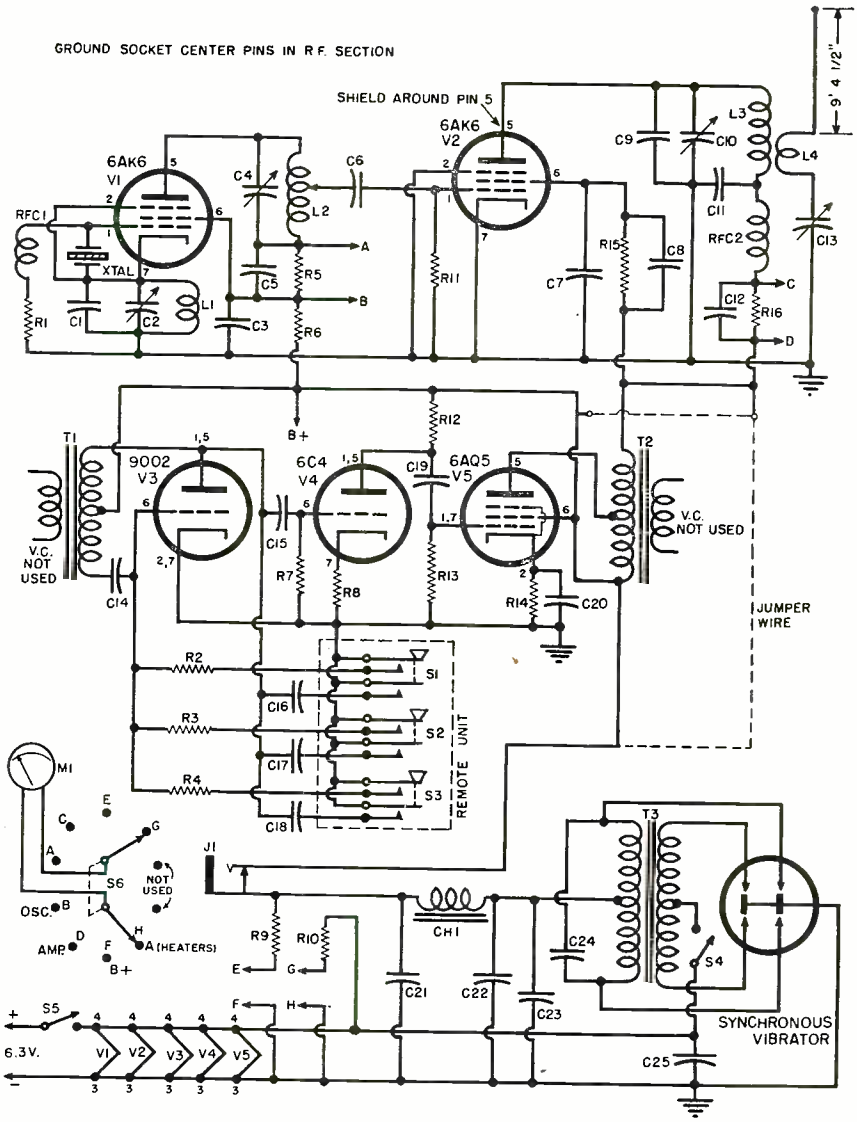


Fig. 2. Complete schematic diagram and parts list for the tone transmitter for R/C. The jumper wire shown dotted is used during the preliminary adjustment of the final amplifier stage. The meter switch positions correspond to points on schematic.

the oscillator section, take care to keep r.f. leads at least one-half inch from the chassis.

Wire the heater circuit next, using the chassis as one lead. Insert the heater switch, S_5, in the hot lead from the battery. Run a short lead to the "B+" switch, S_1, from the S_5 terminal connecting to the heater circuit. Connect the other side of switch S_4 to a terminal strip in the vibrator section

(Continued on page 95)

Fig. 3. Top view of the tone transmitter with the audio subchassis on the left. The two binding posts on the top of the front panel were used in the original design and can be omitted.

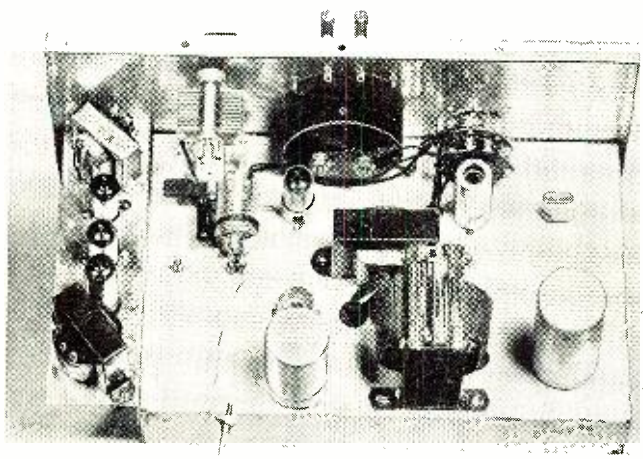
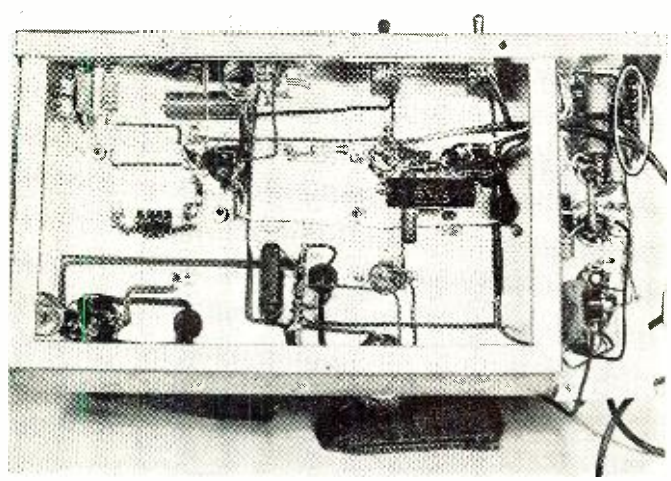
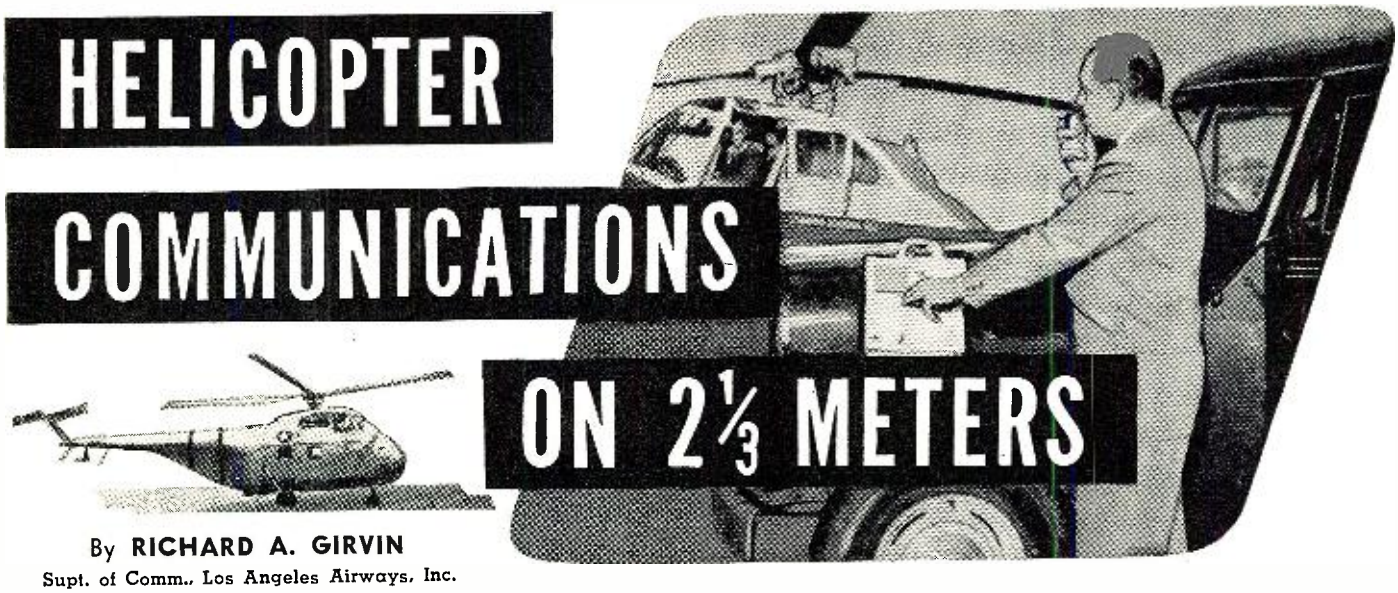


Fig. 4. Bottom view showing parts layout. The box containing the switches for transmitting the tones is connected to the main chassis by means of the terminal strip on the subchassis.



HELICOPTER COMMUNICATIONS ON 2⅓ METERS



By **RICHARD A. GIRVIN**
Supt. of Comm., Los Angeles Airways, Inc.

Two-way radio coordinates the operations of Los Angeles' helicopter airline, permitting split-second scheduling.

A UNIQUE dispatching system which handles the movements of trucks, trains, motor vehicles, and even aircraft is in operation at Los Angeles' airport to coordinate the split-second schedules of a helicopter airline whose life-blood is derived from its ability to meet the most rigorous timetables.

Los Angeles Airways provides helicopter airmail, air express, and passenger service to this southern California metropolitan area.

In order to provide such service the dispatcher has at his fingertips a two-way radio system which covers airborne, vehicular mobile, and fixed subordinate stations on a single channel as provided by the new FCC ruling 9.1103 *et al.*

The complete coordination of these many variables is an absolute "must" for this airline which operates within a 50-mile radius of downtown Los Angeles with 72 schedules daily and which monthly carries in excess of a half-million pounds of airmail, nearly 100,000 pounds of air express, as well as providing direct passenger connections and split-second accuracy with 275 airline schedules daily.

Airmail messengers from the post office, express trucks, and passenger vehicles meet the helicopters at their landing sites, known as "heliports," located strategically in the various cities and their movements are coordinated through the radio control from the dispatch center located at the Los Angeles International Airport.

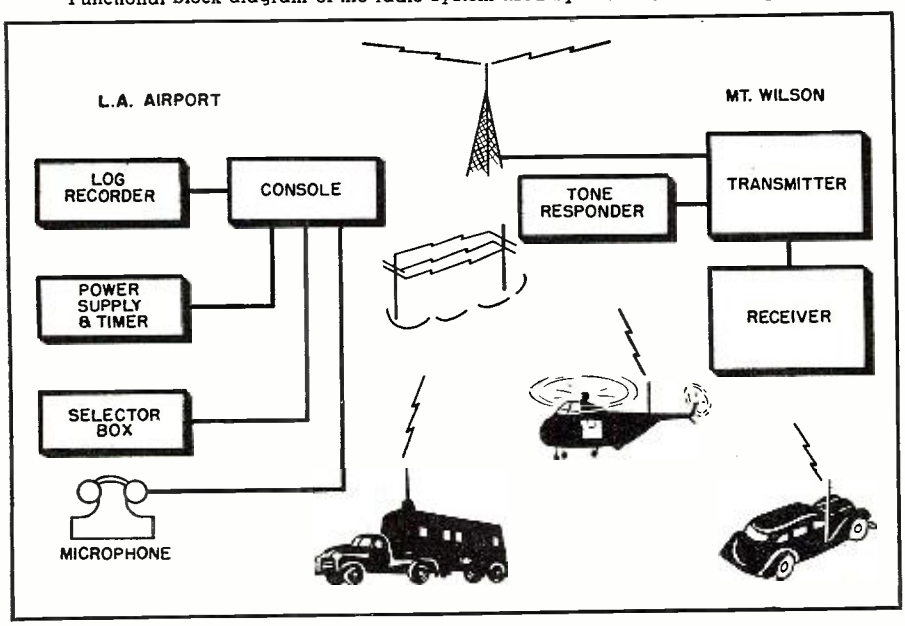
This communications system which consists of a remotely-controlled transmitter on Mt. Wilson (the base station) was placed in service on November 22, 1954, a bare two hours before the inauguration of the airline's passenger service, and represents many years of planning and development by the airline. Use of v.h.f. frequency was dictated by the fact that the aircraft operate in the control areas of several airports which maintain movement control on the v.h.f. band and duplication of airborne equipment for dual-band operation would place an undue weight penalty on the helicopter.

The equipment used in the helicopters is the military T-23/ARC-5, R-28/ARC-5-MD7/ARC-5 combination modified for eight channels. The problem then was to obtain authorization from the FCC for two-way communications with the aircraft as well as two-way communications with the ground elements of this complex helicopter system. Lengthy negotiations resulted in the establishment, by the FCC, of the new "Aeronautical Metropolitan Area" station authorization which was tailored around the helicopter airline requirements and assigned an operating frequency of 127.7 mc. AM.

A base station site that could "see" into the three geographical areas was the next problem. The two ranges of mountains that trisected the system demanded that the site be high enough to provide the "line-of-sight" requirements of v.h.f. Mt. Wilson was chosen and the *Pacific Telephone Company* was given the job of providing and maintaining the base station with its remote control site at the Los Angeles Airport.

The problem of a "mobile" and subordinate station for ground vehicles was solved by using the commercial brother of the *Gonset* "Two-Meter Communicator" which consists of a crystal-controlled transmitter and crystal-controlled receiver known as the Model 3043SX. The *Gonset Company* made a number of modifications to adapt its equipment for this system and hams who have used this two-meter gear will agree that its ver-

Functional block diagram of the radio system used by Los Angeles Airways, Inc.



satility as a mobile as well as fixed station would lend itself to this application.

For a mike, the operators turned to *American Microphone Company* for a suitable unit. The firm recommended its C501C, a coil-cord carbon unit. Subsequent tests showed good results and the microphone was added to the ground station package.

Further modifications were necessary, however, to provide adequate circuit control. This "party-line" type of system could be saturated quickly without a "net-control" for traffic. Further, the system could be rendered useless by virtue of the very fact that made it possible—the high elevation of the base station. That is, subordinate stations in one valley could intercommunicate and not realize that they were transmitting at the same time as other subordinate or mobile stations in one of the other valleys with the end result that the system would be blocked.

The control system adopted was the *Motorola* "Quik-Call". This system provides that the mobile and subordinate stations can only be activated by the base station. This makes for better circuit utilization and efficiency since remote operators are not saturated with traffic between other stations of the system. The remote operator knows that when the receiver is turned on and a message is transmitted that the message is for his station.

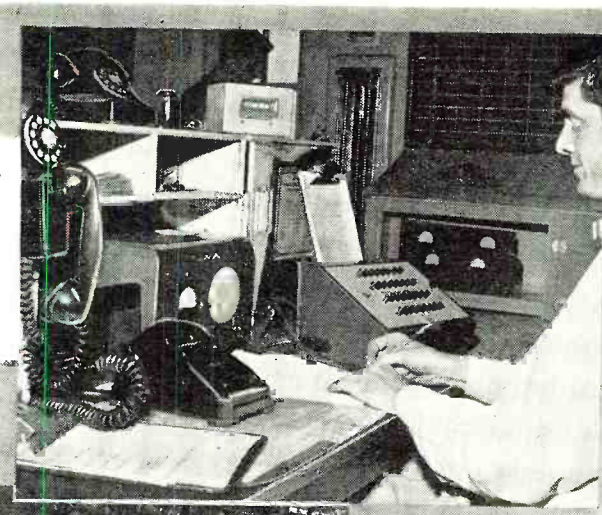
Needless to say, the commercial equipment for this installation all required some modification to adapt it to the particular requirements. In some instances the modifications were simple ones consisting of the additions of capacitors to alter the relay operation, modification of the audio output circuits, etc.

The system as it now stands permits the dispatcher to issue "group calls" to seven individual stations at a time. This feature is used in transmitting blanket messages of concern to the entire segment of the system or can be used to locate a calling station whose identification may have been missed.

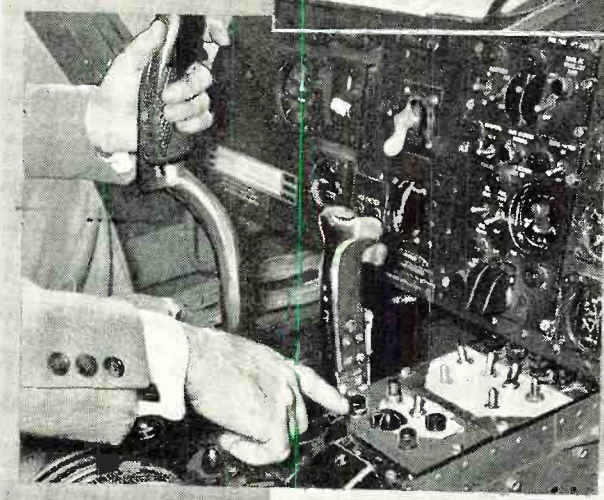
Another feature is that the "Quik-Call" can be used to turn the transmitter on or off. The base station is linked with its remote control site, some 25 air miles distant, by a single audio pair, and through the use of this feature of the tone system the base station is automatically turned on when the dispatcher depresses his microphone switch. The transmitter is keyed on and holds until the dispatcher releases his microphone switch.

Future planning includes the installation of tone responders in the aircraft to relieve pilots of the chore of listening to traffic not concerning their flight.

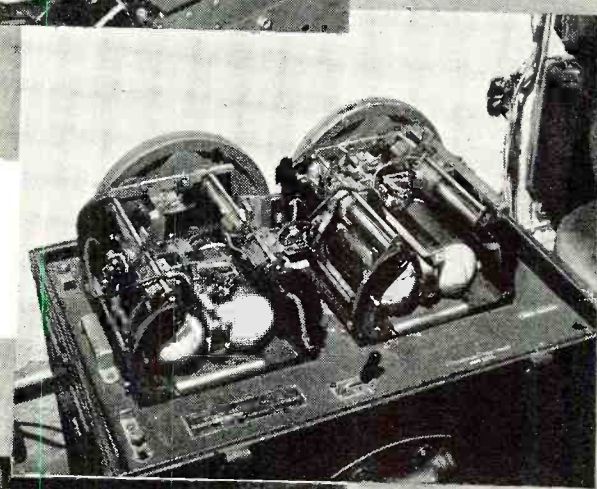
The system is presently licensed for 17 stations but will be expanded as required. The passenger and mail-express flights are currently utilizing all facilities—so such expansion will be needed soon. —30—



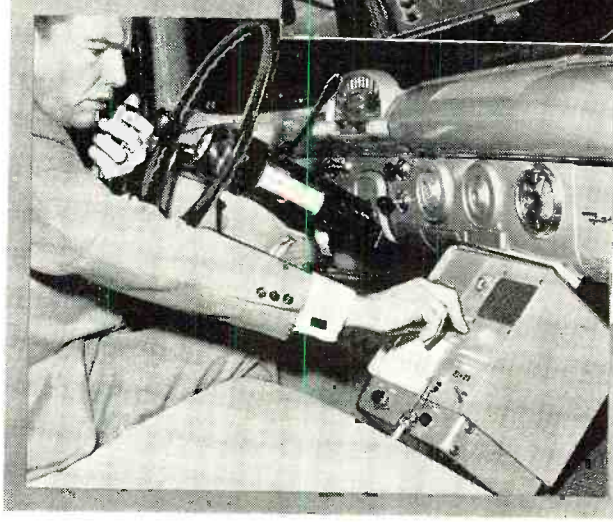
Communications operations center of L. A. Airways showing interoffice phones, communications system handset, selector box, consolette, and tower monitor.



Cockpit of Sikorsky S-55 showing airborne radio control unit. Radio keying switch is on stick.



Base station automatic recording system for recording transmission to and from all units of the radio system.



A mobile communications unit installed in a LAA car.

THE "SOUPED-UP VIKING I"

Front view of the author's "Viking I" after modification. Note the 660 holes that have been drilled in the top for heat dissipation. Unit on top of transmitter is a variable voltage adjuster. Refer to text.

By **JOSEPH W. SEMKOW, W7IIP**
Senior Field Engineer
Raytheon Manufacturing Company

How one ham "hot-rodded" his "Viking I" to provide increased power. A similar technique could be applied to other rigs.

MOST of us are not happy with our transmitters for very long, with the result that we are constantly striving to get the utmost out of our rigs. For the three years that the author has been operating his *Johnson* "Viking I" at an average input of 200 watts, he has been deluged with questions from other hams on how they, too, could duplicate this operation. A number of these questioners have adapted the circuitry to their own rigs and are enjoying similar performance. For the benefit of other "Viking I" owners, the changes will be described in this article.

Whenever it is possible to increase power 3 db (twice power) without too much expense or too great difficulty, the technique for accomplishing this increase is well worth investigating. The added power helps make up for other deficiencies that may exist in the ham station, such as poor antenna or location and QRM. Before going ahead with the suggested changes to your "Viking," certain principles and points should be understood by the reader. Facts will be presented and substantiated by meter readings.

The author's transmitter was purchased second-hand and has been in operation for over three years. Operating time averaged about 1500 hours per year at 200 watts. No major part failures have occurred. The original 4D32 tube is still in the circuit and has never shown any perceptible color on its plate. Plate voltages on the 4D32 and 807 modulators are 800 volts d.c. Plate current to the final amplifier averages between 275 and 285 ma. Static plate current on the 807 modulators averages 75 to 85 ma. On modulation peaks it increases to approximately 200 ma. Slight coloring of the plates is visible but does not hinder or harm any of the components.

Grid current is always adjusted at this station until no further increase in antenna power output is noted. Any current in excess of the necessary amount for optimum output is wasted in tube heating and harmonic generation.

The manufacturer of the "Viking" transmitter rates the power transformer and filter choke as capable of 350 ma. continuous duty at normal temperatures. Most transformers and chokes can sustain considerable overloading without any failure if some method of cooling is provided. This will be one of the modifications required. The transformers are encased in a dust shell which also protects the windings from getting scuffed or damaged. They are so well enclosed that the windings do not get ventilated and cooled. Directions are given in another part of this article for cooling the transformers. Before modification, the 4D32 operated conservatively at 600 volts d.c. and 250 ma. as suggested by the manufacturer, but extensive tests conducted by the author over a three-year period at inputs in excess of 200 watts (800 volts d.c. @ 250 to 300 ma.) have resulted in no apparent damage to the tube or other components.

To increase the audio power output of the 807 modulators and improve the general quality of the "Viking I" some changes are made to the speech amplifier and driver stages. In the original "Viking," as designed by the manufacturer, a 6AU6 type tube was utilized to drive the 807 modulators. This was adequate when powers of 50 or 60 watts were desired for inputs of 100 to 120 watts. When the power to the final is "souped-up" to 200 watts input, this becomes inadequate. The following steps were taken. First, it was decided that it was poor policy to try to drive the 807 modulators with a high impedance driving source such as the 6AU6 tube. It is a much better voltage amplifier than a power driver. The author made up a small right-angle aluminum bracket and mounted a miniature socket on this bracket. This assembly was mounted underneath the chassis of the "Viking" near the speech amplifier circuits (see photo). A 6AQ5 was installed in the socket and wired as a triode. The former 6AU6 driver circuit, of course, was disconnected.

The original feedback loop from T_1, the modulation transformer, to the cathode of the former 6AU6 driver is removed and modified as follows: The new negative feedback loop consists of R_{11} and C_9. The feedback is now impressed on the cathode of the driver and helps correct for any distortion that may be created in either the driver or modulator stages.

The former 6AU6 is now utilized as a voltage amplifier to drive the 6AQ5. The screen resistor is changed to a 1 megohm, ½ watt unit similar to the first stage 6AU6. Both stages now have 1 megohm screen resistors. Additional filtering is added to the screens in the form of 20 μfd. capacitors (see schematic). The cathode resistor of the second 6AU6 (former driver) is now changed to a 2000 ohm, ½ w. unit. Degenerative feedback is encouraged at this point and no capacitor should bypass this cathode.

By shunt-coupling the driver tube to the driver transformer T_3 we improved the quality. No d.c. current on the primary results in the absence of magnetizing current and its associated ill effects on the transformer.

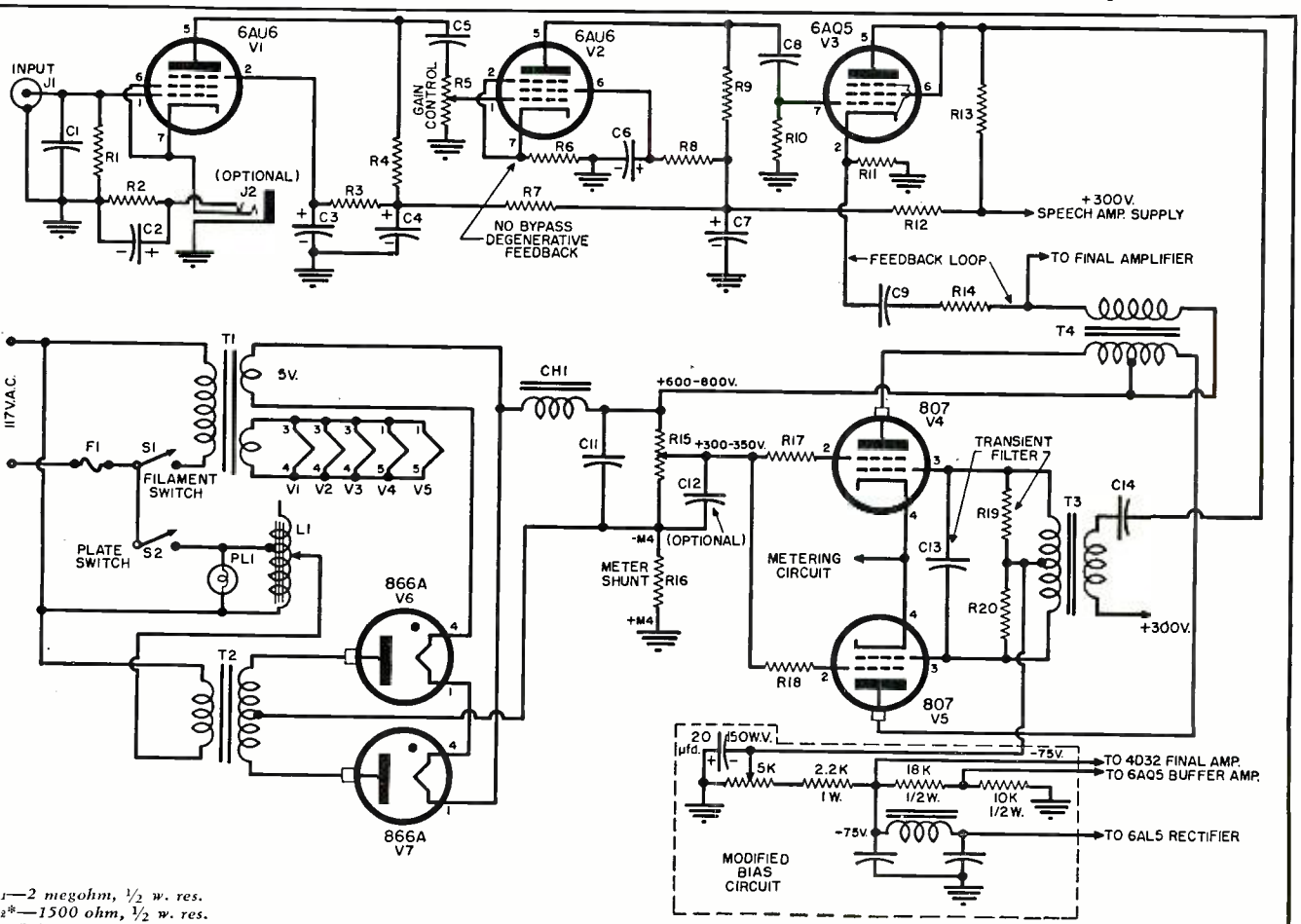
Now we increase the power output capabilities of the "Viking" transmitter. First, remove the 5R4G rectifiers and their associated octal sockets. Install two 4-prong *Amphenol* or equivalent sockets. Rewire the filament circuit so that it is in series across both of the sockets rather than in parallel. This provides 2½ volts a.c. across each tube socket. Install 866A type rectifiers of the 3B28 type. Do not try 816's or 866 Jr.'s as they cannot handle the current needed. Do not be concerned about the slight additional filament current requirements of the 866's. Bring the transformer high-voltage leads to the top caps of the 866A's and you have completed another step in the

modification. Just making this change alone without having done anything else to your transmitter will improve performance. It does two things. It eliminates the former high voltage internal drop of the 5R4G. This drop varies with load which makes the problem more severe. The modulator current does vary considerably under modulation, therefore, the internal resistance in the 5R4G rectifiers varies and provides poor regulation. You probably have already noticed that under 100% modulation, plate current in the final amplifier varies considerably under modulation. With the 866A installation you will note a stabilizing of this final amplifier current variation and also a decided increase in plate voltage. The voltage which previously was approximately 600 to 650 volts d.c. will now be from 650 to 720 volts d.c., with correspondingly increased current drawn by both the final amplifier and modulator.

With the change to 866A's and increased high-voltage output, static current on the modulators will have to be correspondingly reduced as suggested in the *Johnson* manual. Adjust the tap on R_{15}, the bleeder resistor, until you draw approximately 75 to 80 ma. At this point it might be mentioned that additional filtering, in the form of a 30 or 40 μfd., 450 v. capacitor, would not impair transmitter quality if it were installed from the tap to ground. This additional filter would tend to hold the screen voltage variations to a minimum under modulation. This is desirable but not necessary. Changing the bleeder to a higher value would be also desirable, although not necessary. It would help to reduce the heat caused by the increased voltage now across the bleeder

To further increase power so that you can operate at 200 watts input or better, another modification is necessary. The rectifier change will permit a power input of from 150 to 175 watts but the next change will permit a further increase in power. At the rear and center of the "Viking" chassis there is room to mount another *Amphenol* 4-prong socket. If you already have a line voltage adjuster then your expenses are minor. If you don't own such a unit you will have to "big deal," "beg," or buy one. A short cable connects the adjuster to the back of the "Viking" chassis *via* a 4-prong plug which plugs into the socket therein. The high-voltage primary is brought out to this socket. If one decides to sell his transmitter it is a simple process to insert a dummy plug with appropriate jumpers and restore the "Viking" to its original condition, less the adjuster. See schematic on this modification. The line-voltage adjuster provides a means of lowering the voltages for "tune-up" purposes and operation with lower power for local "rag-chewing." This provision is deemed neces-

Schematic diagram of the "Viking I" with the changes incorporated as suggested by the author. The starred items in the parts list were added to the original circuit. A few miscellaneous parts, such as sockets, etc., are not specified.



R_1—2 megohm, ½ w. res.
R_2—1500 ohm, ½ w. res.*
R_3, R_8—1 megohm, ½ w. res.*
R_4—250,000 ohm, ½ w. res.
R_5—500,000 ohm pot ("Gain Control")
R_6—2000 ohm, ½ w. res.*
R_7, R_{12}, R_{14}*—50,000 ohm, 1 w. res.*
R_9—330,000 ohm, ½ w. res.*
R_{10}—250,000 ohm, ½ w. res.*
R_{11}—1000 ohm, 1 w. res.*
R_{15}—10,000 ohm, 10 w. wirewound res.*
R_{13}—50,000 ohm tapped wirewound bleeder (original used 20,000 ohm unit, see text)*
R_{16}—Meter shunt
R_{17}, R_{18}*—100 ohm, ½ w. res.*
R_{19}, R_{20}*—15,000 ohm, ½ w. res.*

C_1—50 μμfd. mica capacitor (r.f. filter)*
C_2—20 μfd., 25 v. elec. capacitor*
C_3, C_6*—20 μfd., 450 v. elec. capacitor*
C_4, C_7*—30 μfd., 450 v. elec. capacitor*
C_5—.02 μfd., 600 v. capacitor*
C_8—.05 μfd., 600 v. capacitor*
C_9—.05 μfd., 1500 v. oil-filled capacitor*
C_{10}—Omitted
C_{11}—10 μfd., 1000 v. capacitor
C_{12}—40 μfd., 450 v. elec. capacitor*
C_{13}—.003 μfd., 500 v. mica capacitor*
C_{14}—1 μfd., 600 v. capacitor*
T_1—Filament transformer
T_2—Plate transformer

T_3—Driver transformer
T_4—Modulation transformer
S_1, S_2—S.p.s.t. switch
J_1—Microphone jack (input for crystal mike)
J_2—Closed-circuit jack (for optional carbon mike)
CH_1—Filter choke
PL_1—115 volt pilot light
F_1—Fuse
L_1—0-135 v. a.c. line-voltage adjuster (General Radio Type 200 CU or equiv.)
**Additional parts required for modification*
See also the parts listed in the modified bias circuit shown within dotted box on diagram.

sary since the "Viking" is now a "hot-rod" and must be operated as such. This is particularly important when changing bands where it is possible for the final amplifier to be far from resonance and operating with full grid drive. When the line-voltage adjuster is cranked wide open so that one has approximately 130 volts on the primary of the high-voltage transformer it causes a decided increase in exciting current of the primary. This appears in the form of heat and brings us to the problem of adequate cooling.

Although the author's "Viking" has been operated for over three years without cooling recently the following precautions have been adopted. Formerly it was impossible to touch the top of the transmitter case or any of the internal parts, especially the transformers. The heating was considerable. After some research into the possible harmful effects of heating on transformers and other components the following changes were made. See photos of perforated top of the transmitter case and transformer shells.

You may find some better means for mounting your blower or may decide to use another type; nevertheless, a blower is advisable. The author mounted a small 4-bladed blower just above the crystal holder and on the vertical aluminum shield which divides the crystal compartment from the final amplifier. See photo. The blade hangs over the vertical shield and part of the blast cools the 4D32 and the remainder moves the heat which collects at the upper part of the case. Transformers T_2 (high voltage) and T_4 (modulation) as well as CH_1 (filter choke) are dismantled. The shells are removed and drilled as indicated in the photographs. A number of holes are drilled into the upper top, sides, and bottom sides to provide a chimney effect for air movement near the windings. Some of the wind from the fan penetrates these holes for cooling. Six-hundred and sixty ⅛" holes are drilled ½" apart on the top case to further vent any heat. With this additional modification it was possible to operate at 250 watts input with room temperatures of 75 degrees for several hours and upon checking the temperature of the transformers and cabinet found that they were only comfortably warm. Cooling should be a "must" in the modification of the "Viking."

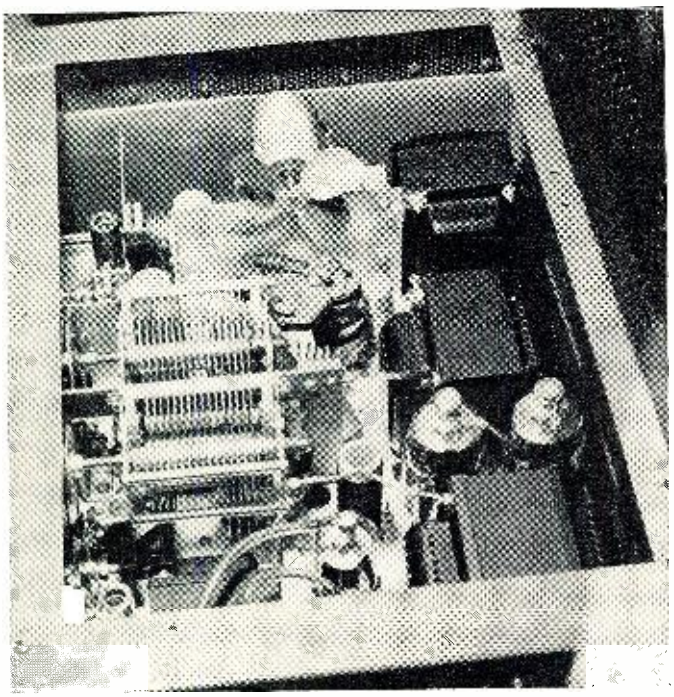
By the way, while you have the shell removed from the modulation transformer it is a good idea to bring the 807 plate leads out the top of the shell through ¼" grommets.

Another worthwhile modification is the adjustable modulator bias provision. With the increased plate voltage applied to the modulator one should correspondingly increase the negative bias to the 807's. This problem can be easily remedied by referring to the schematic and following information. Assuming the negative bias to be from —35 to —40 volts at full power, one can readily see that when the plate voltage is reduced in order to work some local or to operate at, say, 50 watts input, a condition arises where the bias voltage would be excessive and in the cut-off region of the 807's. This would cause excessive distortion at low power. By merely drilling a ⅜" hole just above the "drive-control" on the front panel and mounting a standard 5000 ohm, 2 watt potentiometer, we can control the bias to suit any condition. Wire the control and bias circuits as per schematic.

We should take hints from our good friends in the high-fidelity business and use ample decoupling and filtering in the speech amplifier. This transmitter is capable of exceptional quality if wired in the manner indicated in the schematic. Contrary to general belief that all that is necessary is communications quality, the author of this article firmly believes that good quality will work more DX than restricted speech response. By nature and in our everyday life, we as individuals are accustomed to listening to a reasonably wide range of frequencies both extreme lows and the highs. When we endeavor to modify this to some limited range, we create a falsetto or unreal situation. How many times have you tried to listen to a phone signal when your receiver was switched into the crystal sharp position. All you saw was your "S" meter reading, possibly, an "S7" level but practically no audio was audible. Therefore, it behooves us not to cut out the lows excessively or we have no modulation when listened to by sharp receivers. Conversely, if we reduce highs excessively and encounter a great deal of QRM no intelligence is possible. A signal with a good share of highs can often be read when the receiver is considerably detuned from the carrier frequency. Too wide a bandpass, of course, takes up considerable room in the spectrum. To summarize, the author feels that too much stress is placed on reducing the lows because they consume too much power and too many restrictions on the highs likewise cause a dropping of intelligence.

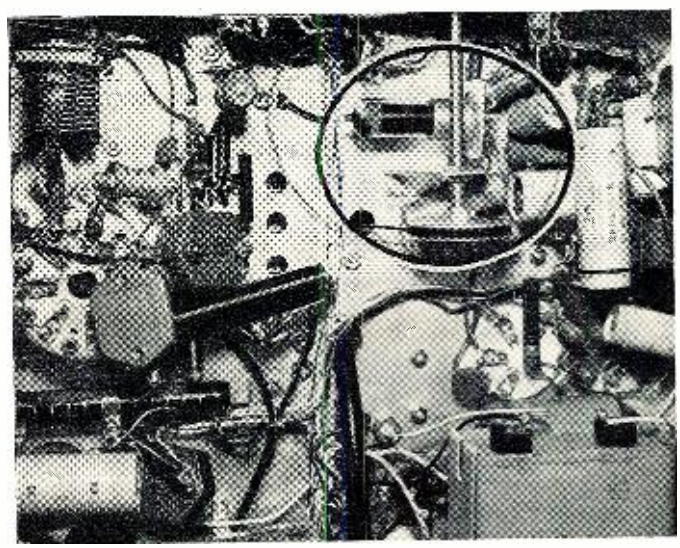
The modified "Viking" will give excellent audio response from 70 to 5000 cycles. The quality will be relatively free from excessive phase shift and distortion and should have clean sidebands. Transmitters equipped with clippers and limiters improperly adjusted can do more to mess up the amateur bands than transmitters not so equipped. Often we read articles claiming 3 db or more increased power output by just adding a clipper or limiter (audio), but careful listening and study will reveal that although 3 db more signal is available to the modulator it is of a type loaded with distortion. The human ear is accustomed to

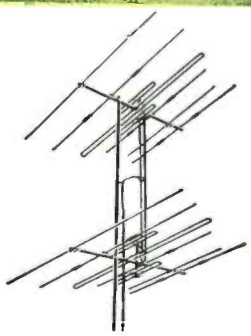
(*Continued on page* 120)



Top view of the transmitter showing the cooling procedures adopted. Note holes drilled in transformer cases and in top and the four-blade blower mounted above the crystal section.

A portion of the bottom chassis view of the transmitter. The circled section shows how the new 6AQ5 driver tube is mounted.





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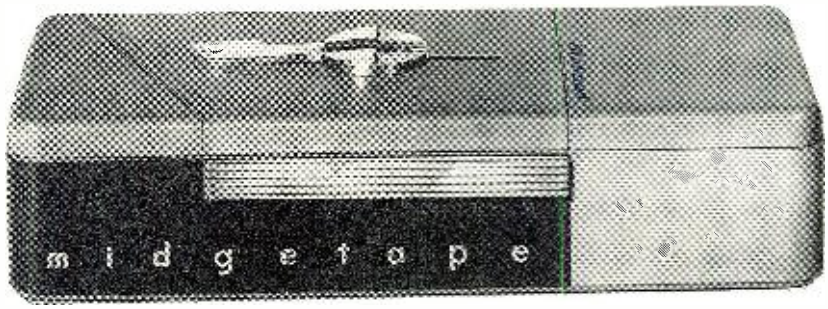


Over-all view of the new Mohawk recorder.

Details on the world's first pocket tape recorder which handles a full hour's conversation with 100% accuracy.

THE world's first pocket-sized, battery-operated tape recorder which measures a mere 8½" long, 3⅞" wide, and 1⅞" deep and weighs just three pounds, one ounce, has been unveiled to an eager public.

Designed especially for salesmen, lawyers, business executives, reporters, doctors, students, sales engineers, etc., this new *Mohawk* unit will record a full hour's conversation with 100 percent accuracy. The magnetic tape is wound inside a cartridge, about the size of a pack of cigarettes, which is simply slipped into the instrument with no tape threading required. The tape itself is ¼" iron oxide, plastic base twin-track *"Mylar"* type.

The recorder operates at 1⅞ ips and the recorded material can be played back through any suitable amplifier or an accessory amplifier with a 2" speaker, which is available for use with this recorder. A headphone jack is included for that type of listening if desired.

The recorder has only three controls, records for a full hour on its dual-track tape, and simultaneously erases old material as new recordings are made. Rewind is manual. The three controls consist of an "on-off" switch, "playback-record," and "volume." Color marks on the volume control function as the recording level indicator.

Frequency response is 200 to 5000 cps, which makes the recorder suitable for voice recording of the non-musical variety.

Power for this unit is obtained from two hearing-aid type batteries. The motor-filament battery life is estimated to be approximately 45 hours. The "B" battery life has been set at 100 hours. A battery-life indicator in the form of a small light goes off when the battery has less than two hours recording life remaining.

The motor operating voltage is 9 to 7 volts d.c. while the filament voltage for the two CK549DX's and the one CK542DX is 1.3 volts d.c. The "B" supply voltage is 30 volts. The motor speed control consists of an electro-mechanical governor.

The input is high impedance, permitting any good microphone to be used with this recorder. The output is 3 milliwatts at 2000 ohms. Signal-to-noise ratio is 40 db and over-all gain is 70 db. Two sockets, one for the microphone and the other for the earphone-amplifier, are incorporated.

The recorder comes complete with a recording cartridge, batteries, crystal microphone, and earphone—the whole unit retailing for $229.50.

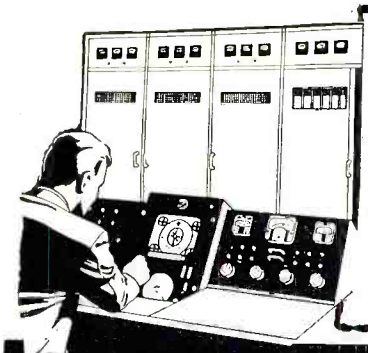
In addition to the original equipment, a variety of accessories is available for use with the recorder, including extra recording cartridges, a throat microphone, "wristwatch" microphone, crystal microphone, concealable lapel microphone, a telephone adapter, the previously-mentioned amplifier with its 2" speaker, an external power supply, a carrying case, battery packs, single and double earphones, microphone extension cords, a shoulder "holster" for carrying the unit, etc.

One important feature of this recorder is that it will operate anywhere, even when the user is traveling by car, plane, or train. The small recording cartridge is mailable—a nice feature for the traveling business executive.

Plans are underway to offer a special briefcase housing for the recorder and a foot pedal for operating the device. These accessories are still under development but will be offered shortly by the manufacturer.

As pointed out previously, this recorder is not intended to be used for high-fidelity recording and playback. Rather, its function is to provide a permanent record of conversations, etc., for business purposes.

The "Midgetape" is available at leading photographic, recording, and business machine dealers throughout the United States. For information on where it can be seen in certain areas, contact the manufacturer, *Mohawk Business Machines Corporation,* at 944 Halsey Street, Brooklyn 33, N.Y. —30—



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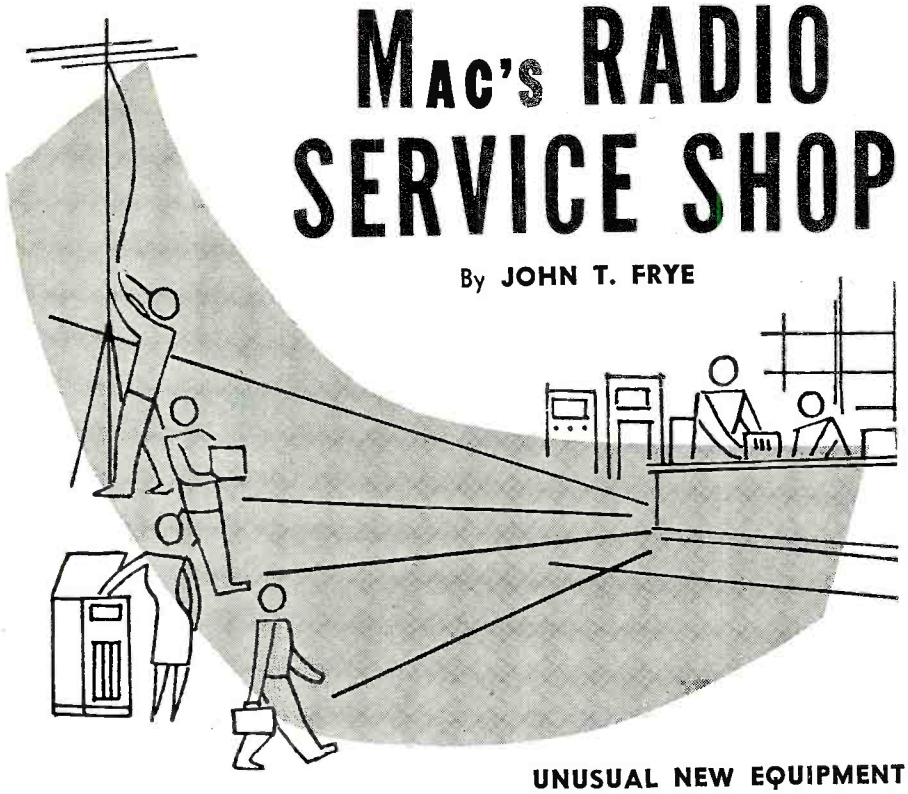
MAC'S RADIO SERVICE SHOP

By JOHN T. FRYE



UNUSUAL NEW EQUIPMENT

BARNEY was a little late to work, and he was hurrying, so he almost knocked down the customer emerging from the service shop carrying a tape recorder in his hand. However, with the quick reflexes of youth, he not only managed to avert the near collision but transformed it into a flourishing gesture of holding open the door. As he hurried into the service department of the radio and TV repair shop he found Mac, his boss, busily engaged in applying a coating of high-voltage shellac, or "corona gunk" as it was familiarly known, to the secondary coil of a horizontal deflection transformer that had developed a "blow-out" at a point where a primary lead had sagged against the winding.

"There," Mac said as he put the combination cork-and-application-brush back into the bottle, "when it dries, that ought to hold the arc. That's the third coating I've put on, and each layer is supposed to provide about 10,000 volts worth of insulation. Unless the winding itself has been damaged, we've probably saved the owner the cost of a new transformer. Don't turn this set on, though, until that dope has thoroughly dried. It'll catch fire when it's wet."

Barney was not paying too much attention. Instead he was eyeing three intriguing-looking boxes the parcel post man had left lying on the bench. "What's in these?" he demanded.

"Three pieces of rather out-of-the-ordinary service equipment," Mac said as he began opening the smallest package. "You know I've always maintained a service technician ought to snoop around a bit in other fields now and then to see if he can't find equipment there that will make his own job easier. What you see here is the result of taking some of my own advice. First, there is this little transistor receiver that measures only five inches by three inches by an inch and a quarter. It's the very first practical transistor radio to hit the market, and it's a true superhet, with two i.f. stages, a.v.c. ferrite core antenna, and earphone jack for a hearing-aid type earphone accessory. I think it can be very useful to us in service work."

"How?"

"I'll show you just as soon as I insert this 22½-volt hearing aid battery that powers it," Mac said as he snapped the back of the case on the little set and turned it on. Instantly the shop was filled with a surprising amount of volume. "Watch now," Mac said as he turned the receiver slowly about with his hand. At two points, one hundred and eighty degrees apart, the volume of the reception fell off sharply.

"When I was playing with one of these at the store, I noticed the null positions of the receiving loop were very sharp and positive. That gave me the idea we can take the little set up on roofs with us and use this directional characteristic to aim TV antennas. Every city with a TV transmitter around here also has one or more radio stations that can be easily picked up on this sensitive little job. As far away as we are, the radio tower and the TV antenna in each of these towns can be considered as being in the same direction from us for all practical purposes. S-o-o-o, all we have to do is find out where the little receiver says the radio station is and then point the TV at that point of the compass, and we'll have it right on the nose. What's more, this little set will be a jim-dandy to tuck in your shirt pocket when you are going out on a noisy reception complaint. You can tell at once if the noise is in the set or not. And I anticipate that in many cases this tiny little portable will lead us right to the source of the noise."

"You know what I think?" Barney asked as he watched Mac fondling the plastic case of the little set.

"No, and I'm not sure I want to find out," Mac replied cautiously.

"I think you're just trying to hatch up some good reasons so you can buy that little set and charge it up to the shop."

"Could be!" Mac said with a guilty grin. "I never could resist as neatly an engineered piece of electronic gear as this is; and when you consider it is the *first* practical transistor receiver—well, you know I still have the first crystal receiver I built and my old Radiola II—"

"Okay," Barney said with an understanding smile. "I don't blame you a bit. What's in those other packages?"

"Here's a pair of prism binoculars," Mac said as he removed them from their leather case. "They are made in the American zone of Germany; and while they are quite reasonable in price, they have a lot of good features. They are seven power and have 35 mm. objectives. All air-to-glass optical surfaces are coated with magnesium fluoride for better light transmission and to cut down reflections. Central focussing is used with provision for separate adjustment of the right-hand barrel. They have a hinged bridge and weigh only 16½ ounces and the field of view is 405 feet at 1000 yards."

As he chanted off these features, Mac walked to the front of the store and gazed through the binoculars at the rooftops across the street.

"Hey, let me look," Barney said as he tugged at Mac's elbow.

Obediently Mac surrendered the glasses, and Barney peered through them.

"Holy cow!" he exclaimed as he lowered the binoculars and then glanced through them again. "These things are powerful. Those TV antennas look like they're standing right outside the window. I can see every bolt, wing-nut, and rivet in them. These things surely show up my coffee nerves, though. It's hard to hold them still."

"That's why I didn't buy higher-powered ones," Mac explained. "Seven-power glasses are about as strong as can be satisfactorily hand held. At that, they make anything seem seven times closer than it really is. Few towers around here exceed seventy feet; so that means we can bring the antenna down to ten feet with the glasses. My thought is that these glasses will save a lot of leg work in climbing around on roofs and towers to inspect antennas and lead-ins. By watching the antenna while it is turned with the motor, we can spot troubles such as broken lead-lines, irregular motor action, loose elements or stacking bars, broken insulators,

(*Continued on page* 121)

Heathkit PRINTED CIRCUIT 5" COLOR TV Oscilloscope Kit

MODEL 0-10

$69.50

Shpg. Wt. 27 lbs.

The technical specifications for this fine instrument speak for themselves. Vertical channel sensitivity is 0.025 volts RMS/inch at 1 Kc. Vertical frequency response is essentially flat to 5 Mc, and down only 1.5 db at 3.58 Mc. Ideal for Color TV work!

Extended sweep generator range is from 20 cps to 500 Kc in five steps, far beyond the range normally encountered at this price level.

Other features are: plastic-molded capacitors for coupling and by-pass—preformed and cabled wiring harness—Z axis input for intensity modulation—peak-to-peak voltage calibrating source built-in—retrace blanking amplifier—regulated power supply—high insulation printed circuit boards—step attenuated and frequency compensated vertical input circuit—push-pull horizontal and vertical amplifiers—excellent sync. characteristics—sharp, hairline focusing—uses 5UP1 CRT—extremely attractive physical appearance.

An essential instrument for professional Laboratory, or for servicing monochrome or color TV.

Heathkit PRINTED CIRCUIT 3" OSCILLOSCOPE KIT

This light, portable 3" oscilloscope is just the ticket for the ham, for service calls, or as an "extra" scope in the shop, or lab. Measures only 9½" H x 6½" W x 11¾" D, and weighs only 11 lbs.

Employs printed circuit board for improved circuit performance. Vertical amplifiers flat within +3 db from 2 cps to 200 Kc. Vertical sensitivity 0.25 volts RMS/inch peak-to-peak, and sweep generator operates from 20 cps to 100,000 cps. R.F. connection to deflection plates.

MODEL OL-1

$29.50

Shpg. Wt. 14 lbs.

Heathkit PRINTED CIRCUIT 5" OSCILLOSCOPE KIT

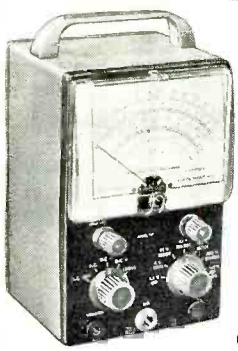
This full-size 5" Oscilloscope incorporates many outstanding features.

Vertical channel flat within +3 db, 2 cps to 200 Kc, with 0.09 volts RMS/inch peak-to-peak sensitivity at 1 Kc. Sweep operation from 20 cps to 100,000 cps. Built-in peak-to-peak voltage calibration—3 step frequency compensated input attenuator—phasing control—push-pull deflection amplifiers. Printed circuits for reliable performance and reduced construction time.

MODEL OM-1

$49.50

Shpg. Wt. 26 lbs.



Heathkit PRINTED CIRCUIT VACUUM TUBE VOLTMETER KIT

MODEL V-7

$24.50

Shpg. Wt. 7 lbs.

This VTVM has set a new standard for accuracy and reliability in kit-form electronic instruments. Features modern, time-saving printed circuits, and functional arrangement of controls and scales. Includes new peak-to-peak scale for FM and TV work.

Measures AC (RMS) and DC voltage at 0-1.5, 5, 15, 50, 150, 500, and 1500; peak-to-peak AC voltage at 0-4, 14, 40, 140, 400, 1400, and 4000; center-scale resistance readings of 10, 100, 1000, 10,000, 100 K, 1 meg., and 10 meg. DB scale provided also. Zero-center operation within range of front panel controls Polarity reversal switch—200 μa 4½ meter-transformer power supply—11 megohm input impedance — 1% precision resistors — high quality components used throughout.

Heathkit 20,000 ohms/volt MULTIMETER KIT

MODEL MM-1

$29.50

Shpg. Wt. 6 lbs.

Features comprehensive range coverage. 20,000 Ω/V D.C. and 5000 Ω/V A.C. Ranges: 0-1.5, 5, 50, 150, 500, 1500, and 5000 V. direct current from 0 to 150 μa., 15 a. in 5 steps. Center-scale resistance of 15, 1500 and 150,000 ohms, and db from —10 to +65.

Uses 1% precision resistors—50 μa. meter—molded bakelite case.

Heathkit DIRECT-READING CAPACITY METER KIT

Extremely valuable where speed and convenience are essential. Quality control work, production line checking, etc. Reads capacity directly on meter scale, from 0-100 mmfd, 1000 mmfd, .01 mfd, and .1 mfd. Residual capacity less than 1 mmfd. Not susceptible to hand capacity.

MODEL CM-1

$29.50

Shpg. Wt. 7 lbs.

Heathkit A. C. VACUUM TUBE VOLTMETER KIT

MODEL AV-2

$29.50

Shpg. Wt. 5 lbs.

Measures AC voltage only, from 10 cps to 50 Kc. Covers the range from 1 millivolt to 300 volts in 10 steps at high impedance input. Incorporates full 10 ranges of db scale from —52 db to +52 db. Essential in the audio laboratory or for audio enthusiasts and experimenters. Provides sensitivity essential for low level audio measurements.

Heathkit ELECTRONIC SWITCH KIT

This device will electronically switch between 2 input signals to produce both signals alternately at the output. Used in conjunction with an oscilloscope, it will permit the observation of 2 signals simultaneously. Provides switching rates from 10 cps to 200 cps.

MODEL S-2

$23.50

Shpg. Wt. 11 lbs.

Heathkit VOLTAGE CALIBRATOR KIT

Once calibrated, this instrument provides a known peak-to-peak voltage standard for comparison with unknown voltage values on an oscilloscope. Panel calibrated directly—no involved calculations required. Operates within a voltage range of .01 to 100 volts peak-to-peak.

MODEL VC-2

$11.50

Shpg. Wt. 4 lbs

HEATH Company

A SUBSIDIARY OF DAYSTROM INC.

BENTON HARBOR 15, MICHIGAN

SELECT YOUR NEXT HEATHKIT FROM

Heathkit TUBE CHECKER KIT

MODEL TC-2
$29.50
Shpg. Wt. 12 lbs.

Because of its low price this fine tube tester is available, not only to the service shop and laboratory, but to part-time servicemen, experimenters, and radio amateurs, as well. Will test all tubes commonly encountered in radio and TV service work. Simple "GOOD—BAD" scale on the 4½" meter. Tests for open, short, and quality on the basis of total emission. Includes illuminated roll chart. Fourteen different filament voltage values available. Separate lever switch for each tube element.

Model TC-2P is the same electrically as TC-2, except that it is housed in a beautiful two-toned portable carrying case. Only $34.50. Shpg. Wt. 15 lbs.

Portable carrying case available separately for Model TC-2, or older model TC-1. Cab. No. 91-8, $7.50. Shpg. Wt. 7 lbs.

CRT Test Adapter, Model 355 for use with the TC-2, $4.50. Shpg. Wt. 1 lb.

Heathkit TV ALIGNMENT GENERATOR KIT

Here is the complete R.F. signal source for FM and TV alignment, (both monochrome and color). Provides output on fundamentals from 3.6 Mc to 220 Mc in four bands, with harmonic output usable up through the UHF channels. Electronic sweep circuit eliminates mechanical gadgets and accompanying noise, hum, and vibration. Continuously variable sweep up to 0—42 Mc, depending on base frequency.

Variable marker (19—60 Mc on fundamentals) and crystal marker (4.5 Mc and multiples thereof) generators built-in. Crystal included with kit. Provision for external marker if desired.

Packed with outstanding features. 50 ohm output impedance — exceptionally good linearity—effective AGC action—plenty of R.F. output. An essential instrument for the up-to-date service shop.

$49.50

MODEL TS-4
Shpg. Wt. 16 lbs.

MODEL SG-8
$19.50
Shpg. Wt. 8 lbs.

Heathkit SIGNAL GENERATOR KIT

This is one of our most popular kits, and is "serviceman engineered" to fulfill the signal source requirements of the radio serviceman and experimenter.

Covers 160 Kc to 110 Mc on fundamentals (5 bands), with output in excess of 100,000 microvolts. Calibrated harmonics extend usefulness up to 220 Mc. Choice of unmodulated R.F. output, 400 cps modulated R.F. output, or 400 cps audio output. Step-type and continuously variable output attenuation controls.

Coils are prewound, and construction manual is complete. Calibration unnecessary for service applications.

Model RS-1

Heathkit RESISTANCE SUBSTITUTION BOX KIT

Provides switch selection of 36 RTMA 1 watt standard 10% resistors, ranging from 15 ohms to 10 megohms. Numerous applications in radio and TV work.

$5.50
Shpg. Wt. 2 lbs.

Heathkit CONDENSER SUBSTITUTION BOX KIT

Model CS-1
$5.50
Shpg. Wt. 2 lbs.

Very popular companion to Heathkit RS-1. Individual selection of 18 RTMA standard condenser values from .0001 mfd to .22 mfd. Aluminum panel, bakelite case, and includes 18" flexible leads with alligator clips.

Model DR-1

Heathkit DECADE RESISTANCE KIT

Twenty 1% precision resistors provide resistance from 1–99,999 ohms in 1 ohm steps. Indispensable around service shop, laboratory, ham shack, or home workshop.

$19.50
Shpg. Wt. 4 lbs.

Heathkit DECADE CONDENSER KIT

Provides capacity values from 100 mmf to 0.111 mfd in steps of 100 mmfs. +1% precision silver-mica condensers used. High quality ceramic wafer switches for reduced leakage.

Model DC-1

Shpg. Wt. 3 lbs.
$16.50

Heathkit CONDENSER CHECKER KIT

Model C-3
$19.50
Shpg. Wt. 7 lbs.

Measures capacity in four ranges from .00001 to 1000 mfds. Power factor control is provided for indication of electrolytic condenser efficiency. Tests capacitors under actual load conditions. Checks resistance from 100 ohms to 5 megohms. Direct reading scales for all tests. No calculation necessary.

Model LG-1

Heathkit LABORATORY GENERATOR KIT

$39.50
Shpg. Wt. 16 lbs.

Here is a signal generator for use where high accuracy and metered performance are essential. Covers 150 Kc to 30 Mc on fundamentals in 5 bands. 400 cps modulation variable from 0 to 50%. R.F. output at 50 Ω from 100,000 to 1 μv. Meter reads R.F. output in μv. or modulation percentage. Fixed-step and variable output.

Model T-3

Heathkit VISUAL-AURAL SIGNAL TRACER KIT

$23.50
Shpg. Wt. 9 lbs.

This signal tracer features a high-gain R.F. channel and probe to permit signal tracing from the receiver antenna input through the R.F. and I.F. stages. Separate low gain channel for audio circuits. Both visual and aural indication by means of speaker and electron beam "eye" tube.

Also noise locater circuit, wattmeter, and terminals for "patching" output transformer or speaker into external circuit.

Model M-1

Heathkit HANDITESTER KIT

$14.50
Shpg. Wt. 3 lbs.

The M-1 is literally pocket size to fit in your coat pocket, tool-box, glove compartment, or desk drawer. Measures A.C. or D.C. v. in 5 steps from a full scale minimum of 0—10 v. to a maximum of 0—5000 v. Measures direct current at 0—10 Ma and 0—100 Ma, and provides ohmmeter ranges of 0—3000 and 0—300,000 ohms. Sensitivity of 1,000 ohms v. 1% precision divider resistors employed.

HEATH Company

A SUBSIDIARY OF DAYSTROM INC.

BENTON HARBOR 15, MICHIGAN

THESE HIGH QUALITY INSTRUMENTS

Heathkit HARMONIC DISTORTION METER KIT

MODEL HD-1
$49.50
Shpg. Wt. 13 lbs.

Performs the functions of more elaborate and much more expensive audio distortion testing devices and yet is simple to operate and inexpensive to own. Used with a sine wave generator, it will check the harmonic distortion output of audio amplifiers under a variety of conditions. Essential in audio design work.

The HD-1 reads harmonic distortion directly on the meter as a percentage of the original signal input. It operates from 20 to 20,000 cps in 3 ranges, and incorporates a VTVM circuit for initial reference settings and final harmonic distortion readings. VTVM ranges are 0—1, 3, 10, and 30 volts full scale. 1% precision voltage divider resistors used. Distortion meter scales are 0—1, 3, 10, 30 and 100% full scale. Having a high input impedance the HD-1 requires only .3 volt input for distortion tests.

Heathkit AUDIO ANALYZER KIT

MODEL AA-1
$59.50
Shpg. Wt. 13 lbs.

The AA-1 consists of an audio wattmeter, an AC VTVM, and a complete IM analyzer, all in one compact unit. It offers a tremendous saving over the price of these instruments purchased separately.

Use the VTVM to measure noise, frequency response, output gain, power supply ripple, etc. Use the wattmeter for measurement of power output. Internal loads provided for 4, 8, 16, or 600 ohms. VTVM also calibrated for DBM units so db gain or loss can be noted quickly.

High or low impedance IM measurements can be made. High (6 Kc) and low (60 cps) frequency generators built-in. Only 4 meter scales are employed, and one of these is in color so that results are easily read on the scale. Full scale VTVM ranges are .01 to 300 volts in 10 steps, full scale wattmeter ranges are .15 mw to 150 w in 7 steps. IM analyzer scales are 1%, 3%, 10%, 30% and 100%.

Heathkit AUDIO GENERATOR KIT

MODEL AG-8
$29.50
Shpg. Wt. 11 lbs.

This basic audio reference generator deserves a place in your Laboratory. Complete frequency coverage is afforded from 20 cps to 1 Mc in 5 ranges, and output is constant within ±1 db from 20 cps to 400 Kc, down only 3 db at 600 Kc., and 8 db at 1 Mc. An extremely good sine wave is produced, with a distortion percentage below 0.4% from 100 cps through the audible range.

Plenty of audio output for all applications; up to 10 v. under no load conditions. Output controllable with a continuously variable or step-type attenuator with settings of 1 μv, 100 μv, 1 v, and 10 v. Cathode follower output.

Heathkit VARIABLE VOLTAGE POWER SUPPLY KIT

Model PS-3
$35.50
Shpg. Wt. 17 lbs.

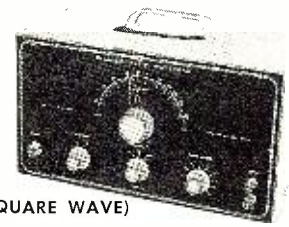
Provides regulated DC output for B+, and 6.3 v. AC at 4 amps. for filaments. Output variable from 0 to 500 v. DC at no load, linear from 0—10 ma at 450 vdc and 0—130 ma at 200 vdc! Essential for circuit design and development. Voltage or current read on 4½" meter.

Heathkit "Q" METER KIT

Model QM-1
$44.50
Shpg. Wt. 14 lbs.

Will measure Q of condensers, RF resistance and distributed capacity of coils, etc. Uses 4½" 50 μa meter for direct indication. Will test at 150 Kc to 18 Mc in 4 ranges. Measures capacity from 40 mmf to 450 mmf within ±3 mmf. Useful for checking wave traps, chokes, peaking coils. Indispensable for coil winding and determining unknown condenser values.

Heathkit AUDIO OSCILLATOR KIT

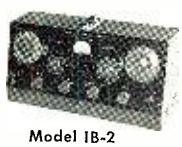


MODEL AO-1
$24.50
Shpg. Wt. 10 lbs.

(SINE WAVE — SQUARE WAVE)

Features sine or square wave coverage from 20 to 20,000 cps in 3 ranges. An instrument specifically designed to completely fulfill the needs of the serviceman and high fidelity enthusiast. Offers high-level output across the entire frequency range, low distortion and low impedance output. Uses a thermistor in the second amplifier stage to maintain essentially flat output through the entire frequency range. Produces good, clean square waves with a rise time of only 2 microseconds.

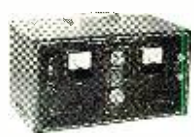
Heathkit IMPEDANCE BRIDGE KIT



Model IB-2
$59.50
Shpg. Wt. 12 lbs.

Measures resistance, capacitance, inductance, dissipation factors of condensers, and the storage factor of inductance. Employs 2-section CRL dial. D, Q and DQ functions are combined in one control. ½% resistors and capacitors used in critical circuits. 100—0—100 microammeter for null indications. 1000 cycle oscillator, 4 tube detector-amplifier, and power supply built-in.

Heathkit 6-12 VOLT BATTERY ELIMINATOR KIT



Model BE-4
$31.50
Shpg. Wt. 17 lbs.

Furnishes 6 or 12 volt output for the new 12 v. car radios in addition to 6 v. models. Two continuously variable output voltage ranges; 0—8 v. DC at 10 A. continuously or 15 A. intermittent, 0—16 v. DC at 5 A. continuously or 7.5 A. intermittent. Output voltage is clean and well filtered by two 10,000 mfd condensers. Panel meters read voltage and current output.

Heathkit BROADCAST BAND RECEIVER KIT

MODEL BR-2
$17.50
(Less Cabinet)
Shpg. Wt. 10 lbs.

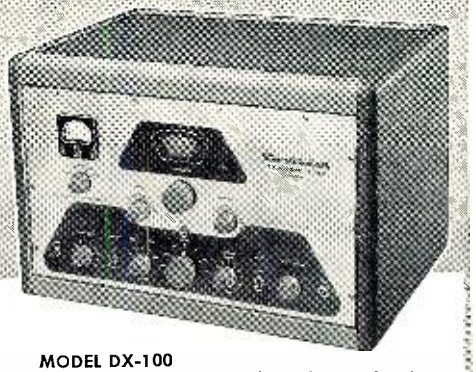
Build your own receiver with confidence. Complete instruction book anticipates your every question.

Features transformer-type power supply, high-gain miniature tubes, built-in antenna, planetary tuning from 550 Kc to 1600 Kc, 5½" speaker. Also adaptable for use as AM tuner or phono amplifier.

CABINET: Fabric covered plywood cabinet available, complete with aluminum panel and re-inforced speaker grille. Part No. 91-9, Shpg. Wt. 5 lbs., $4.50

HEATH Company
A SUBSIDIARY OF DAYSTROM INC.
BENTON HARBOR 15, MICHIGAN

New Heathkit DX-100 PHONE AND CW TRANSMITTER KIT



This one compact package contains complete transmitter, with built-in VFO, modulator, and power supplies. Provides phone or CW operation—VFO or crystal excitation—and band-switching from 160 meters through 10 meters. R.F. power output 100—125 watts phone, 120—140 CW. Parallel 6146's modulated by push-pull 1625's. Pi network interstage and output coupling for reduced harmonic output. Will match non-reactive antennas between 50 ohms and 600 ohms. TVI suppressed with extensive shielding and filtering. Rugged metal cabinet has inter-locking seams.

The high-quality transmitter is packed with desirable features not expected at this price level. Copper plated chassis—potted transformers—wide spaced tuning capacitors—ceramic insulation—illuminated VFO dial and meter face—remote control socket—preformed wiring harness—concentric control shafts—high quality, well rated components used throughout. Overall dimensions 20⅞" wide x 13¾" high x 16" deep.

Supplied complete with all components, tubes, cabinet and detailed construction Manual. (Less crystals.) Don't be deceived by the low price! This is a top-quality transmitter designed to give you years of reliable service and dependable performance.

MODEL DX-100

$189.50

Shpg. Wt. 120 lbs.

Shipped motor freight unless otherwise requested. $50.00 deposit required for C.O.D. orders.

Heathkit AMATEUR TRANSMITTER KIT

MODEL AT-1

$29.50

Shpg. Wt. 15 lbs.

Enjoy the trouble-free operation of commercially designed equipment while still benefiting from the economies and personal satisfaction of "building it yourself."

This CW Transmitter is complete with its own power supply, and covers 80, 40, 20, 15, 11 and 10 meters. Single knob bandswitching eliminates coil changing. Panel meter indicates grid or plate current for the final. Crystal operation, or can be excited by external VFO. Crystal not included in kit. Incorporates features one would not expect in this price range, such as key-click filter, line filter, copper plated chassis, prewound coils, 52 ohm coaxial output, and high quality components throughout. Instruction Book simplifies assembly. Uses 6AG7 oscillator, 6L6 final and 5U4G rectifier. Up to 35 watts plate power input.

Heathkit GRID DIP METER KIT

Model GD-1B

$19.50

Shpg. Wt. 4 lbs.

This is an extremely valuable tool for Hams, Engineers or Servicemen. Covering from 2 Mc to 250 Mc, it uses 500 μa meter for indication. Kit includes prewound coils and rack. Will accomplish literally hundreds of jobs on all types of equipment.

Heathkit ANTENNA IMPEDANCE METER KIT

Use in conjunction with a signal source for measuring antenna impedance, line matching purposes, etc. Will double, also, as a phone monitor or relative field strength indicator.

100 μa meter employed. Covers the range from 0 to 600 ohms. An instrument of many uses for the amateur.

Model AM-1

$14.50

Shpg. Wt. 2 lbs.

Heathkit VFO KIT

MODEL VF-1

$19.50

Shpg. Wt. 7 lbs.

Weigh the cost of this kit against the cost of crystals—and consider the convenience and flexibility of VFO operation. This is one of the most outstanding kits we have ever offered for the radio amateur.

Covers 160—80—40—20—15—11 and 10 meters with three basic oscillator frequencies. Illuminated and precalibrated dial scale clearly indicates frequency on all bands and provides more than two feet of dial calibration. Reflects quality design in the use of ceramic coil forms and tuning capacitor insulation, and copper plated chassis. Simply plugs into crystal socket of any modern transmitter to provide coverage of the bands from 160 meters through 10 meters. Uses 6AU6 Clapp oscillator, and OA2 voltage regulator for stability. May be powered from plug on Heathkit Model AT-1 Transmitter, or supplied with power from most transmitters.

Heathkit ANTENNA COUPLER KIT

Model AC-1

$14.50

Shpg. Wt. 4 lbs.

Poor matching allows valuable communications energy to be lost. The Model AC-1 will match your low power transmitter to an end-fed long wire antenna. Also attenuates signals above 36 Mc, reducing TVI. 52 ohm coaxial input—power up to 75 watts—10 through 80 meters.

Heathkit COMMUNICATIONS RECEIVER KIT

Covers 550 Kc to 35 Mc in 4 bands. Features electrical bandspread—separate R.F. and A.F. gain controls—noise limiter—AGC—BFO—phone jack—5½" PM speaker.

CABINET: Fabric covered plywood cabinet. Part No. 91-10. Shpg. Wt. 5 lbs. $4.50

Model AR-2

$25.50

Shpg. Wt. 12 lbs. (Less Cabinet)

HEATH Company

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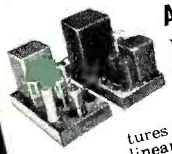
BENTON HARBOR 15, MICHIGAN

Heathkit DUAL-CHASSIS WILLIAMSON TYPE HIGH FIDELITY AMPLIFIER KIT



Main amplifier and power supply each have their separate chassis for flexibility of installation. Features the Acrosound "ultra-linear" output transformer. Frequency response within ±1 db from 10 cps to 100,000 cps. Power output is over 20 watts.

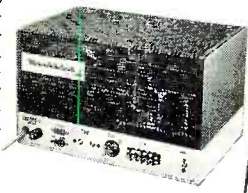
KIT COMBINATIONS

W-3M: Consists of main amplifier and power supply for separate construction. Includes all tubes, components, and complete assembly instructions. Shpg. Wt. 29 lbs., Exp. Only $49.75

W-3: Consists of W-3M Kit listed above *plus* Heathkit Model WA-P2 Preamplifier. Shpg. Wt. 37 lbs., Exp. Only . . . $69.50

Heathkit ADVANCED DESIGN *High Fidelity* AMPLIFIER KIT

This advanced-design 25 watt Hi-Fi Amplifier features a new-design Peerless output transformer, improved circuitry, and uses KT-66 output tubes. This results in higher power output; improved bass and high frequency response; and reduced IM and harmonic distortion. Incorporates all the "extra" features that make for real listening enjoyment. Power handling capabilities increased to follow instantaneous power peak of full orchestra. Also new type balancing circuit, and "tweeter saver" to suppress HF oscillation. New physical design results in attractive appearance, suitable for use either in or out of a cabinet.



KIT COMBINATIONS

W-5M: Consists of main amplifier and power supply for single chassis construction. Includes all tubes, components, and complete assembly instructions. Shpg. Wt. 31 lbs., Exp. Only **$59.75**

W-5: Consists of W-5M Kit listed above *plus* Heathkit Model WA-P2 Preamplifier. Shpg. Wt. 38 lbs., Exp. Only **$79.50**

Heathkit SINGLE-CHASSIS WILLIAMSON TYPE HIGH FIDELITY AMPLIFIER KIT

This is the lowest priced Williamson-type Amplifier ever offered in kit form. Main amplifier and power supply on a single chassis. Features Chicago output transformer. Flat within ±1 db from 10 cps to 100,000 cps. Maximum power output over 20 watts.

KIT COMBINATIONS

W-4M: Consists of main amplifier and power supply for single chassis construction. Includes all tubes, components, and complete assembly instructions. Shpg. Wt. 28 lbs., Exp. Only $39.75

W-4: Consists of W-4M Kit listed above *plus* Heathkit Model WA-P2 Preamplifier. Shpg. Wt. 35 lbs., Exp. Only $59.50

Heathkit 6-WATT AMPLIFIER KIT

Model A-7B

$15.50

Shpg. Wt. 10 lbs.

Model A-7B; although not classified as a true high fidelity amplifier, this Heathkit Amplifier provides full 6 watts power output, more than adequate for normal- home installation, and frequency characteristics are ± 1½ db from 20 to 20,000 cps. Push-pull output—detailed construction manual—top-quality parts. Output transformer tapped at 4, 8, and 15 ohms. Bass and treble tone controls provided. Two input channels.

MODEL A-7C: Same as Model A-7B except with preamplifier stage. Shpg Wt. 10 lbs., $17.50

Heathkit HIGH FIDELITY PREAMPLIFIER KIT

Model WA-P2

$19.75

Shpg. Wt. 7 lbs.

Beautiful modern appearance blends with any interior color scheme.

Completely fulfills all the requirements for remote control, compensation, and preamplification for the Heathkit Williamson-type Amplifiers or any conventional Hi-Fi Amplifier. Five separate input channels, each with separate audio level control. Full record equalization accomplished with 4-position turnover and roll-off controls.

Separate bass and treble controls. Overall frequency response within 1 db from 25 cps to 30,000 cps. Hum and noise level extremely low. This brilliant performer will do justice to the finest available program sources.

Heathkit 20-WATT HIGH FIDELITY AMPLIFIER KIT

Model A-9B

$35.50

Shpg. Wt. 23 lbs.

Here is your least expensive route to real high fidelity performance. Full 20 watt output—separate bass and treble tone controls—frequency response ±1 db 20—20,000 cps—four switch-selected, compensated inputs—low hum and noise level—output transformer tapped at 4, 8, 16, and 500 ohms. Single chassis construction combines preamplifier, main amplifier, and power supply in one unit.

HEATH COMPANY • Benton Harbor 15, Mich.

MAIL YOUR ORDER TODAY TO THE
HEATH COMPANY
A SUBSIDIARY OF DAYSTROM INC.
BENTON HARBOR 15, MICHIGAN

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Please ship C.O.D. ( ) postage enclosed for pounds.

On Express orders do not include transportation charges—they will be collected by the express agency at time of delivery.
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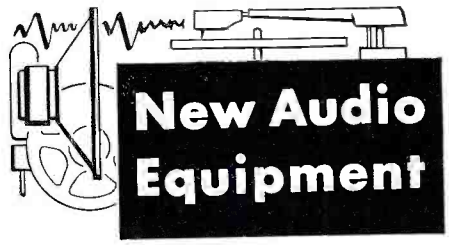
ON PARCEL POST ORDERS include postage for weight shown.

ORDERS FROM CANADA and APO's must include full remittance.



E-V "SKYLARK"

Electro-Voice, Inc., of Buchanan, Mich., has recently introduced a complete three-way loudspeaker system which is housed in an attractive, compact cabinet designed to be placed on a table, in a bookcase, or on the wall.

Tradenamed the "Skylark", the cabinet measures 33" wide, 14" high, and 10¾" deep. It incorporates two tapered horn ports which load the SP8C

low-frequency and mid-range reproducer from 70 to 3500 cps. The company's T35B very-high-frequency tweeter takes over at 3500 cps to beyond audibility.

Currently available in mahogany and Korina blonde finishes, the new system covers from approximately 70 cps to 15,000 cps, ±6 db. Complete electrical and mechanical specifications on this system are included in Bulletin No. 219, which is available from the company on request.

LOW-COST FM TUNER

Granco Products Inc., 36-17 20th Avenue, Long Island City 5, N. Y., has added a second low-cost FM tuner to its "Music Hall" series.

The Model T-160 features a "paragrid" front panel which incorporates a neat slide-rule tuning dial and two control knobs. The built-in antenna eliminates installation problems.

The circuit features the company's coaxial tuner, five tubes plus selenium rectifier power supply, for a sensitivity of 5 μv. for 20 db. quieting. The selectivity of 200 kc. at 6 db points, with ratio detector peak-to-peak separation of 300 kc. and linear detector response for 180 kc., minimizes any possible interference.

Dimensions are 7¼" wide, 5" high, and 4⅝" deep. The tuner weighs 5 pounds.

MODERN BAFFLE

Lowell Manufacturing Co., 3030 Laclede Station Road, St. Louis 17, Mo., is now offering a new, modernly-con-

toured baffle which is constructed of a series of attractive louvres with an exclusive conical sound diffuser to provide controlled 360-degree dispersion of even, undistorted low-level sound.

The STL baffle is specifically designed for low-ceilinged areas such as restaurants, offices, schools, railway cars, and wired music installations where attractive decor, speaker concealment, and high audio efficiency are requisites.

The baffle will accommodate 6" to 12" speakers and mount to a variety of the company's recessed protective speaker enclosures. The unit is available with a buffed satin aluminum finish or colored lacquer finishes can be supplied if desired.

AUDIO-MASTER ITEMS

Audio-Master Corp., 17 E. 45th Street, New York, N. Y., is now offering several new items to the audio trade.

The firm's standard all-purpose transcription playback machine has been redesigned to permit front-panel operation. The new style offers operational advantages which are especially important in the audio-visual field. The newly-redesigned units incorporate 5-tube push-pull high gain amplifiers, three speed motors, and will handle records and transcriptions up to 17¼ inches in diameter.

The other items include two new hi-fi machines: a portable transcription playback machine (Model A-M #58) and an automatic record changer. Full details on both of these units and on the newly-redesigned transcription playback machines are available from the company on request.

3-SPEED TAPE RECORDER

Bell Sound Systems, Inc., 555 Marion Road, Columbus 7, Ohio, has recently introduced an all-new, three-speed tape recorder, the Model RT-75.

The RT-75 features full push-button control with straight-line slot threading. A positive-action lever permits selection of the three tape speeds, 7½ ips, 3¾ ips, or 1⅞ ips. Frequency response at 7½ is rated at 30 to 12,000 cps; 7500 cps at 3¾ ips; and 4500 cps at 1⅞ ips.

The recorder features exceptionally fast forward and rewind speeds. A standard 1200-foot spool can be rewound in 70 seconds. Controls include volume, tone boost and cut, and push-

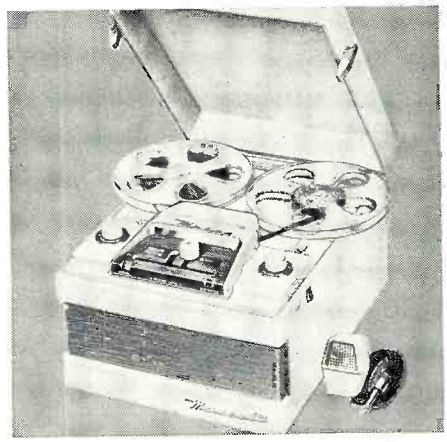
button recording control with safety interlock to prevent accidental erasure. Two microphone inputs are provided in addition to one radio-phono-TV input.

Write to H. H. Seay, general sales manager of the firm, for full details.

MASCO TAPE RECORDER

Mark Simpson Manufacturing Co., 32-28 49th Street, Long Island City, N. Y., recently introduced a new tape recorder for home and semi-professional use, the Model 500.

The new *Masco* recorder has a single shift knob. It is housed in a luggage-



type leatherette carrying case in an ivory and gold motif. The instrument is a dual speed-dual track recorder which takes up to 7" reels. Frequency response is 50 to 12,000 cps ±3 db. Audio power output is 5 watts. A specially-designed 5" x 7" oval speaker is used.

The recorder weighs only 23 pounds with all accessories. These include the 7" reel with 600 feet of tape, an empty take-up reel, a ceramic microphone styled to match the recorder, 10 feet of cable, and a patchcord.

PRE-RECORDED TAPES

Electrosonic Specialties, 7230 Clinton Road, Upper Darby 4, Pa., has announced the availability of a series of pre-recorded background music tapes which will be sold direct to the consumer, under the tradename "Fidelivox".

The currently-available tapes feature Robert Elmore playing a cathedral pipe organ. The tapes are being issued in 2, 4, 6, and 8 hour sections, dual-track. Write the company for full information on the selections and prices of these tapes.

NEW KNIGHT UNITS

Allied Radio Corporation, 100 N. Western Avenue, Chicago 80, Ill., has added two new units to its line of "Knight" audio gear.

The "Knight Bantam" unit is a 12-watt amplifier which is housed in a black and gold finished metal case, ready for use on table top, bookshelf, or mantel. Provisions for behind-panel mounting in custom installations are included. The amplifier measures only 3½" x 13" x 10¼". Frequency response at 12 watts output is ±.5 db from 20

to 20,000 cps. Harmonic distortion is less than 1 per-cent at rated output and intermodulation distortion is less than 2 per-cent at the rated output.

The second unit is a self-powered preamp-equalizer which is designed to serve as a convenient control center for hi-fi music systems or for modernization of existing phono equipment.

It includes separate bass and treble controls, calibrated from —16 db to +16 db to permit adjustment of tonal balance to satisfy personal tastes and to match room acoustics. Five input jacks accommodate all components normally used in a music system. A six-position input selector switch selects these components and provides three positions of record compensation: *ffrr*, RIAA, and "Hicut" for old, noisy records.

Detailed literature on both of these units is available from the company on request.

DISC RECORDER

Excellotone Corporation, 129 Cooper Street, Brooklyn, N. Y., is now in production on a new disc recorder which will record and play at 33⅓ rpm.

The cased, portable unit measures 9" x 12" x 9" and weighs just 16 pounds. It is suitable for home, business, or professional use and may also function as a p.a. system.

The inexpensive, pliable "Exelodisks" are made of pure vinyl, five inches in diameter. They play for 30 minutes. These discs can be stored in

the case of the recorder itself. The unit features a minimum of controls and simplicity of operation.

JIM LANSING SPEAKER

James B. Lansing Sound, Inc., 2439 Fletcher Drive, Los Angeles 39, Calif., has added the "Signature Model 123" to its line of loudspeaker units.

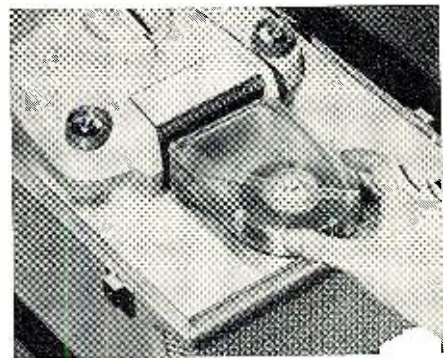
The new speaker is a 12" extended-range type which is compact enough to mount in enclosures which previously required a unit of smaller diameter. With a depth of only 3⅝", the new speaker can be mounted between studding, flush with the surface of any standard wall or partition. The Model 123 is not limited to wall mounting since, according to the company, performance improves when the speaker is enclosed in a reflex cabinet or loaded with a horn.

Usable frequency response range, when used as a direct radiator and en-

closed with an adequate baffle, extends from 30 to 15,000 cps. Power input is 20 watts and impedance is 16 ohms.

TAPE MAGAZINE

A new clip-in tape magazine that eliminates objectionable threading and



rewinding of magnetic recording tape has been developed by *American Molded Products* of Chicago.

Fully enclosed in the magazine, the tape is locked into playing position with slight finger pressure. The magazine is automatically ejected from the machine when the control knob is turned to "eject".

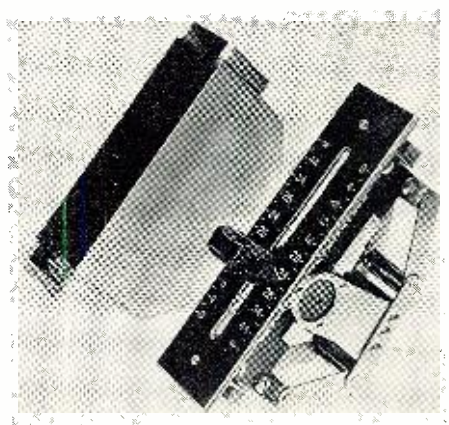
Storage space problems are greatly simplified since over-all dimensions of the entire unit are only 3⅝" x 5⅞₂" x 1". The tape itself is 300 feet long and reels in counterclockwise direction. At the end of the 300 foot span a Mobius loop arrangement automatically transfers playback or recording to the opposite side, thus providing an actual length of 600 feet.

Full details are available from Dept. REN of the company at 2727 W. Chicago Avenue, Chicago 22, Ill.

VERTICAL ATTENUATOR

A new low-cost vertical attenuator covering the audio range has been developed by *Tech Laboratories, Inc.*, 8 E. Edsall, Palisades Park, N. J.

The new attenuator has straight-line, finger-tip operation, accomplished



without any guide rods through the use of a new linkage system that completely eliminates backlash or stickiness, minimizing wear and extending the life of the unit.

Both plug-in and fixed-panel designs are currently available. Standard units are furnished in two sizes of 30 and 20

steps, 30 step units at 1.5 db and 20 step units at 2 db. Ladder, "T," or potentiometer circuits are standard with impedance values for ladders ranging from 30 to 600 ohms and 250,000 ohms for potentiometers.

Complete information is available from the company on request.

REVERE RECORDER

Revere Camera Company of Chicago has just introduced its T-11 tape recorder which is designed especially for professional and custom applications.

Frequency response is 40 to 16,000 cps, ±3 db. The unit has a monitor amplifier with 2½ watts output. Wow and flutter is less than .2 per-cent. Among the patented features included in this new recorder are the firm's "Balanced-Tone" principle which coordinates the amplifier and acoustic system to balance the highs and lows;

automatic head demagnetization; and rapid individual forward and reverse. Solenoid-operated keyboard push-buttons make it possible for untrained personnel to use the unit. The T-11 accepts 3, 5, 7, and 10½ inch reels. It may be mounted and operated in any position.

NEW SPEAKER DESIGN

Stephens Manufacturing Corporation, 8538 Warner Drive, Culver City, Calif., has announced that the free air resonance of its 120LX "Tru-Sonic" low-frequency driver has been lowered by the use of a new cone. The new cone, which is a straight-sided, ribbed cone of low resonance, has cut the free air resonance of the speaker to 45 cps. This results in improved bass response, with lows of 20 cps when the speaker is properly housed, according to the company.

Other features of the 120LX woofer remain the same.

SINGLE NEEDLE CARTRIDGE

Ronette Acoustical Corporation, 135 Front St., New York 5, N. Y., is in production on a series of single-needle "Fonofluid" cartridges for microgroove reproduction exclusively.

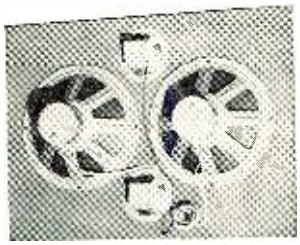
The Type RA-284 has low IM distortion and is of the constant-velocity type when loaded with the correct load resistance of 120,000 ohms.

Available with sapphire or diamond styli, full details on this new cartridge line are available from the manufacturer.

—30—

EW IMPERIAL IV HIGH FIDELITY SPEAKER—SALE PRICE $19.95

25 WATT HI-FI SPEAKERS AND BAFFLE BOARD



2—12" WOOFERS
2— 5" TWEETERS
AND BAFFLE

$24.95

350 CYCLE CROSSOVER $10.00 Extra

Stock No. 4P-SS, four speakers mounted on a ¾" plywood baffle board 21½" x 28½" long. For mounting in your present cabinet or wall-mounting. You save time and trouble of properly mounting and baffling. Equipped with 2—12" heavy magnet woofers and 2—5" tweeters, Reesponse 50 to 18000 cps. Works properly on any radio or amplifier with 3.2 or 8 ohm output. Ship. wt. 20 lbs. List value over $40.00. Sale price, $24.95.
Model X4P-SS, same as above but equipped with a 350 cycle LC type super deluxe crossover for attenuating highs and augmenting low frequency response. Variable control. Sale price, $34.95.

McGee's Famous 12 AND 15 INCH COAXIAL P.M. HIGH FIDELITY SPEAKERS

$12.95 12-Inch Model CU-14Y

$23.95 15-Inch Model P15-CR

Model CU-14Y, 12" high fidelity coaxial PM speaker. Response from 30 to 17,500 cps. Full 6.8 oz. Alnico V magnet in the 12" woofer. Special coaxially suspended high frequency tweeter. Built-in crossover network. Only two wires to connect to your radio or amplifier. Matches 3.2 to 8 ohm output. Don't confuse this speaker with many cheap speakers that are offered. This is a fine quality speaker. Stock No. CU-14Y. Sale price $12.95 each, two for $25.00.
Model P15-CR, 15" high fidelity coaxial PM speaker. Response down to 20 cps. and up to 17,500 cps. Full 21½ oz. Alnico V magnet in the 15" woofer. Specially made, coaxially suspended 5" high frequency tweeter. Built-in crossover network. Only two wires to connect. Matches 3.2 to 8 ohm output transformer. A regular $62.50 list speaker. Model P15-CR, McGee's Sale Price, $23.95.

SPECIAL PURCHASE SALE!

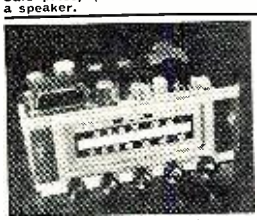
CROSLEY FM-AM TUNER

SALE PRICE **$19.99**

AUDIO AMPLIFIER IS REQUIRED TO OPERATE A SPEAKER

Model 362-2, 6 tube Crosley FM-AM tuner. Receives broadcast, 550 to 1600 kc and FM, 88 to 108 mc. Uses loop antenna for broadcast and has external antenna connections for FM antenna. Complete with tubes: 3—6BA6, 6BE6, 12AT7 and 6T8. Power to operate this chassis is to be picked up from your present audio amplifier or television set. (6.3 volt filament and 125 to 180 volts at 20 mils "B" voltage required.) Chassis size, 5½" deep, 10¾" long, 5⅜" high. Has illuminated slide rule dial 8½" long and 1½" high. 4 position switch on front of chassis selects FM, AM, TV or Phono. Input jack for variable reluctance pickup on back of chassis. One-half of the 6T8 is used as a pre-amplifier for the variable reluctance input. Chassis has no volume control. Audio is fed into your television or High Fidelity amplifier. These are new Crosley FM-AM tuners that cost the factory more than $20.00 to build. Model 362-2, shipping weight 9 lbs. Sale price $19.99. Complete with escutcheon, knobs, diagram, instructions and parts list.
Crosley 362-2VC, FM-AM tuner, same as above, but with volume control and power supply added to make a completely self-powered FM/AM tuner. Shipping weight 10 lbs. Sale price, $24.99. Note: An audio amplifier is required to operate these tuners thru a speaker.

9-TUBE HI-FIDELITY



JACKSON AM9A

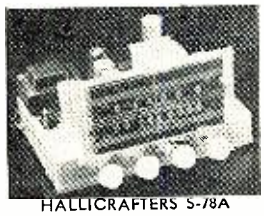
12 Watts Audio
Dual Tone Controls

$39.95 LESS SPEAKER

RECEIVES BROADCAST 550 TO 1650 K.C.

Jackson Model AM9A, 12 watt high fidelity audio amplifier and broadcast tuner combined, at less than you would normally pay for the amplifier alone. Push-pull 6V6 output. Frequency response from 30 to 15,000 cps. Inputs for crystal or G.E. variable reluctance pickup and crystal or dynamic microphone. Separate bass boost and treble tone controls. Radio-phono switch on front of chassis. Shielded output transformer matches 3.2 or 8 ohm speaker. Heavy duty 150 mil power transformer. 9½" illuminated slide rule dial with etched glass scale. 3 gang condenser with tuned R.F. stage and loop antenna. Receives broadcast 550 to 1650 kc. Size 13" long, 6" high and 9½" deep. Complete with tubes: 2-6BA6, 6AU6, 6BE6, 6SN7, 6AT6, 2-6V6 and 5Y3. Knobs, escutcheon, diagram and instructions included.
Model AM9A, Hi-Fi amplifier and tuner. Ship. wt. 9 lbs. Sale price, $39.95
Model AM9A with our CU-14Y 12" coaxial PM speaker, both for $49.95.
Model AM9A with our P15-CR 15" coaxial PM speaker, both for $59.95.

11-TUBE FM-AM HALLICRAFTERS



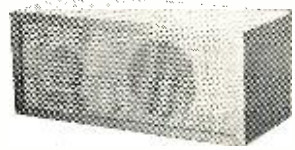
HALLICRAFTERS S-78A

Regular $89.50
McGEE's SALE PRICE **$69.95** LESS SPEAKER

★ HIGH FIDELITY
★ AUTOMATIC FREQUENCY CONTROL

Hallicrafters Model S-78A, 11 tube FM-AM superhet custom classis. Size 7⅜" x 12½" x 11" deep. Complete with tubes, knobs, escutcheon, diagram and instructions. Receives broadcast 540 to 1700 kc, plus FM 88 to 108 mc. AFC holds FM stations in perfect tune. Output transformer matches 3.2 ohm or 500 ohm. High fidelity response, 50 to 14,000 cps. Bass boost tone control. A full 11 tube transformer powered chassis with push-pull 6K6 audio. This chassis found in $400 to $600 radio combinations. Has input for crystal phono pickup. Self-powered preamplifier necessary for G.E. variable reluctance cartridge, $3.95 extra.
S-78A Hallicrafter 11 tube FM-AM chassis. Ship. wt. 22 lbs. $69.95
S-78A Hallicrafter with our CU-14Y 12" coaxial PM speaker $79.95
S-78A Hallicrafter with our P15-CR 15" coaxial PM speaker $89.95

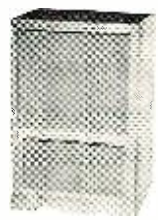
NEW IMPERIAL IV with General Electric 8 in. HIGH FIDELITY SPEAKER



$19.95

New 1955 Model IMPERIAL IV, High fidelity speaker system with General Electric 8" speaker. Housed in a high quality leatherette covered plywood cabinet 10" x 10" x 24" long. Fully enclosed; covered on all sides except back. Use as an auxiliary speaker or with any high fidelity radio, amplifier or home music system. The IMPERIAL IV contains a General Electric Model 850 extended range high fidelity 8" PM speaker with 6.8 oz. Alnico V magnet and curvelinear cone with 8 ohm voice coil and a 5" tweeter. Response 50 to 15,000 cps. Model IV Imperial $19.95.

CONSOLE HIGH FIDELITY SPEAKER SYSTEM

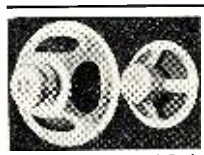


$49.95

EQUIPPED WITH 3 PM SPEAKERS

12 IN. GENERAL ELECTRIC WOOFER
10 IN. MID RANGE SPEAKER
8 IN. GENERALIC MID-HIGH RANGE

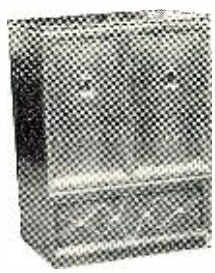
Have Juke Box tone quality in your own home. Strictly High fidelity. Three speakers all connected to a 600 cycle frequency dividing network, so that only 2 wires feed the system from any 4 or 8 ohm radio or amplifier. A variable tone compensating control incorporated in the circuit makes brilliant highs or boomy lows to your own taste. Any amplifier that you now have will give you a much wider selection of acoustical arrangements with this speaker system. The 3-way system is shipped ready to connect to your amplifier or hi-fi radio. Equipped with a General Electric 12" woofer, an 8" famous G.E. 850 plus a 10" middle range speaker. Frequency response 30 to 15,000 cps. Take your choice of cabinets; blonde oak, walnut or mahogany. (Specify finish desired when ordering) 37" high, 24" wide and 20" deep. Ship. wt. 75 lbs. Stock No. HF-33GE, Sale price, $49.95.



HIGH FIDELITY SPEAKERS

8" BLUE STREAK ..... $ 6.95
15" WOOFER $16.95

Model HF-8J, 8" "Blue Streak," High Fidelity wide range speaker. This one speaker properly baffled will give excellent response to both high and low frequencies and terrific response through the very important middle range. Has 6.8 oz. Alnico V magnet with wide range curvelinear cone and 8 ohm voice coil. Response essentially flat from 35 to 12,500 cps. Perfect for high fidelity radios, amplifiers and professional music systems. Ship. wt., 6 lbs., Model HF-8J, Sale price, $6.95.
Model HF-15 J, 15" "Blue Streak," HiFi woofer. Has a 14½ oz. Alnico V magnet with curvelinear one piece cone and 1¼", 8 ohm voice coil. Will give good response from 50 to 9500 cps. Takes 15 to 20 watt peak. Ship. wt. 12 lbs. Sale price, $16.95.

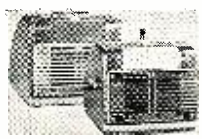


60 WATT CONSOLE AMPLIFIER WITH 3 SPEAKERS $275.00 VALUE

$169.50

$275.00 value 60 watt console auditorium amplifier system for only $169.50. A 43" high, ¾ door mahogany console cabinet that cost $100.00 to build, plus a regular $150.00 dealer value Operadio 60 watt auditorium amplifier. This is a completely assembled amplifier system with a super heavy duty 15" Operadio speaker and 2 heavy 10" PM speakers properly installed and baffled. The 60 watt Operadio Model PA-125 has 4-6L6G's in push-pull-parallel, driven by a 6SN7 with 2-5U4G rectifiers. We have specially designed a pre-amplifier that has two mike inputs with separate gain controls, input for crystal or magnetic phono pickup and bass and treble tone controls. This pre-amplifier may be used in the cabinet or as a remote control. System has a built-in 600 cycle crossover network. Schematic diagram and instructions furnished. This unit sounds like a giant Juke Box. A terrific value if you need lots of audio and plenty of bass response. Stock No. PA-25MAS, 60 watt Auditorium Amplifier System, ship. wt., 130 lbs. Sale price, $169.50.

3-STATION INTERCOM MASTER SUB-STATIONS $3.95 EACH



$16.95

Powerful 3 station intercom master housed in a chrome plated metal cabinet 7½" x 6" x 5". Full 3 tube amplifier for AC-DC operation. Press-to-talk switch is on top of cabinet. Volume control, off-on switch and station selector are located on either side. May be used with one to three sub-stations. Master is quiet except when talk-listen switch is pressed, or when call-back switch is pressed at the sub. Ship. wt. 10 lbs. Model MPM-A3, 3 station master, $16.95. Matching sub-station, Model PM-A5, complete with 5" Alnico V PM speaker and call-back switch. $3.95 each or 3 for $10.00. Requires 3 wire intercom cable, $1.95 per 100 ft., 500 ft. for $8.95.

GARRARD—COLLARO—WEBCOR 3-SPEED RECORD CHANGERS

$65.00 LIST COLLARO 3/532 $38.95

Here are top values in modern up-to-date 3 speed automatic record changers. New Webcor model 114-43, 3 speed automatic changer with RPX-050 G.E. cartridge. Size, 13½" x 12". Ship. wt. 12 lbs. Sale price only $29.95.
Regular $65.00 list Collaro model 3/532, 3 speed automatic record changer made in England. Intermixes 10 and 12" records of same speed. Constant speed 4 pole motor and weighted turntable with molded rubber pallet. Compensating spring to shift weight of tone arm for LP and std. records. Plug-in head will hold any popular cartridge. 14⅜" long, 12¼" wide and 4¾" above motor board, 27/8" below. Available in grey, cream and gold hammertone. Ship. wt. 20 lbs. Regular net, $48.75. Special sale price, $38.95 less cartridge. Large 45 RPM spindle, $2.50 extra. 3/532 Collaro changer with G.E. Golden Treasure RPX-052 cartridge, $58.95.
RC-80 Garrard "Triumph," 3 speed automatic changer. 13¼" wide, 15½" deep and 8" high. 2½" below motor board. Net price, less cartridge, $48.51. 45 RPM spindle $3.43 extra. RC-80 with G.E. RPX-052 Golden Treasure cartridge, Net $68.51. RC-80 with crystal flip-over cartridge, only $52.46.
RC-90 Garrard "Crown," 3 speed automatic changer. 13½" x 15½". 5¾" above motor board and 3⅞" below. Net price, less cartridge, $68.11. With crystal flip-over cartridge, $72.06. With G.E. RPX052 Golden Treasure, $88.11. 45 RPM spindle, $3.43 extra.

McGEE RADIO COMPANY

PRICES F.O.B. KANSAS CITY
SEND 25% OR FULL REMITTANCE WITH ORDER. BAL. SENT C.O.D.

OUR NEW ADDRESS IS
1903 McGEE ST., KANSAS CITY, MISSOURI

REGULAR $59.95 LIST TIMEX MAGNETIC RECORDER

McGEE'S SPECIAL PURCHASE SALE $29.95

RECORDS AND PLAYS BACK—PLAYS 16⅔ AND 45 RPM RECORDS

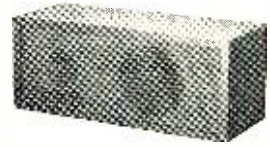
MODEL 40 TIMEX RECORDER $29.95
CRYSTAL PICKUP HEAD TO PLAY PHONO RECORDS $2.95 EXTRA

A product of United States Time Corp. (Timex) A multiple purpose machine made to retail for $59.95. McGee buys a solid carload and you save by buying now at only $29.95, plus $2.95 for a 45 RPM record adaptor and crystal head for 16⅔ or 45 RPM phono records. Records and plays back for 3½ minutes on a wafer thin flexible magnetic disc. Make recordings of your family —use for office dictation—dictate records that may be mailed without breaking. Attractive brown plastic case, 9½ x 11½ x 4⅞". Turntable speeds 16⅔ and 45 RPM. Response 100 to 4000 cps. Amplifier has neon level indicator, volume control and selector knob with playback, record and phono positions. Uses 12AX7, 50C5, 6C4 and 35W4 tubes. Built-in 4" speaker. Complete with Shure variable reluctance microphone. Provides faithful reproduction at low volume of voice or music, recorded through the microphone supplied or direct from your radio or TV. As simple to operate as a record player. Stock No. TIM-RI recorder, ship. wt. 13 lbs. Sale price, $29.95.

Recording discs, package of 6 for 99¢. One blank shipped with recorder.

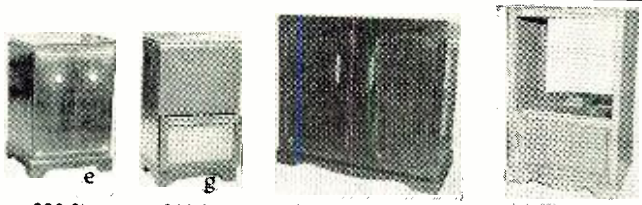
You may purchase a plug-in crystal phono pickup to adapt this recorder for playing 16⅔ or 45 RPM phono records for only $2.95 extra.

SALE PRICE 29.95 MODEL 40 TIMEX



8" EXTENSION SPEAKER $16.95 EXTRA

For $16.95 extra you can have our regular $19.95 Imperial LV extension speaker, equipped with an 8" G.E. speaker as described on the opposite page. When you order this with your Timex recorder we install a jack which makes your Timex play 45 RPM records with better tone quality and with the switch in the record position unit doubles as a small public address system.



e g

$29.95 $19.95 NRT-21M $59.95 BT-210 $22.95

17" FULL DOOR $29.95

Fig. (e) No. AH-430, Mahogany with full doors. 36" h., 24" w., 21¾" deep. Chassis area 22" w., 17¾" h., 18¾" deep. Blank panel. Holds 17" TV easily. Baffle cut for 10" speaker. Ship. wt. 80 lbs. On sale at less than it cost a famous TV factory. Sale price, $29.95.

17" with PHONO DRAWER $19.95

Fig. (g) SE-21, 17" mahogany TV cabinet with phono drawer 40" h., 24" w., 18½" deep. Blank panel. TV chassis area 19" h., 20½" w. Changer drawer 19¾" wide, 13" deep. Baffle cut for 10" speaker. Ship. wt. 75 lbs. Sale price, $19.95.

DELUXE 21" MAHOGANY TV-PHONO CABINET

No. NRT-21M, Deluxe piano finish mahogany combination radio-phono-TV cabinet for 20" or 21" TV chassis. Beautiful full door style with matching front panels. 37" high, 40½" wide and 22¾" deep. Baffle cut for a 12" speaker. TV chassis area 21" high, 23½" wide and 19" deep. Changer shelf 15" x 17" with 9" height clearance. Ship. wt. 90 lbs. No. NRT-21M, mahogany cabinet, sale price, $59.95. 21" mask and safety glass, $6.95 extra. No. A13-9, ball bearing changer drawer slides, $1.39 pr., extra.

21" BLONDE $22.95—MAHOGANY OR WALNUT $19.95

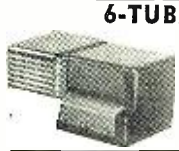
No. BT-210, blonde oak 21" TV cabinet. 37½" high, 24" wide and 20½" deep. TV chassis area 20½" high, 23½" wide and 18½" deep. Baffle cut for 10" speaker. Open front, no blank panel furnished. Shipping weight 85 lbs. Sale price, $22.95. No. WT-210, walnut 21" TV cabinet, same as above, Sale price, $19.95. No. MT-210, mahogany 21" TV cabinet, same as above, Sale price, $19.95.

RMS VHF TV BOOSTER $4.95

Latest RMS TV booster for all VHF channels. Continuously variable for channels 2 thru 13. Variable gain control prevents overloading on powerful stations. Brown plastic case 4½" x 5½" x 5". Operates on 110 volt, 60 cycle AC. Ship. wt. 4 lbs. Model SP-6, RMS TV booster, special sale price only $4.95.

6-TUBE, 2-BAND RADIO KIT $14.95

6-18 MC 550-1650 KC



6 tube, 2 band AC-DC radio kit, complete with speaker and plastic cabinet. Popular with schools and colleges for training in radio. Receives broadcast and 6-18 mc shortwave. Full 2 gang superhet with 5" speaker and slide rule dial. A complete kit with tubes: 12K8, 2—12SK7, 12SQ7, 50L6 and 35Z5, diagram and instructions. Cabinet 13" x 6¾" x 6¼". Ship. wt. 12 lbs. Model ME6-2, Net $14.95.

3-SPEED AMPLIFIED PLAYER KIT $10.95
2 TUBE AMPLIFIER—8" SPEAKER

New, 3 speed amplified record player kit for only $10.95. Leatherette covered cabinet 9½" x 12" x 13½" high, made to set on floor. Completely wired 2 tube amplifier has separate tone and volume controls, 12BF6, 35W4 and 50B5 tubes. Heavy 8" speaker, all play pickup, motor and turntable. Cabinet is precut. All you have to do is fasten the amplifier, speaker and motor in the cabinet. Only a few minutes required to assemble. Complete with simple, easy to follow instructions and all necessary items to build this 3 speed amplified record player. Buy this kit at less than the cost of the parts. Shipping weight 15 lbs. Model No. RP-743K, Sale price only $10.95.

50-WATT BOOSTER AMPLIFIER

50-WATT BOOSTER AMP. $39.95

2-Mike Pre-Amp $12.95 Extra. Not a Kit, but a Manufactured Amp.

A sensational value. A 50 watt booster amplifier with push-pull, parallel 6L6 output tubes. Connect to your present amplifier as a booster or use with the PR-2X pre-amplifier to allow the use of 2 microphones and one low level input. The amplifier has one input jack with 1 volt input giving 50 watts of audio. Amplifier has a 6 lb. potted case high fidelity output transformer with taps at 4-8-16-60 and 250 ohms. 225 mil power transformer and 5U4G rectifier. Includes tubes: 4—6L6, 7N7 and 5U4G. Two variable tone controls for master volume and bass boost tone control. Chassis size, 8" x 6½" x 14½". Model No. PA-55N. Ship. wt. 26 lbs. Sales price, $39.95. PR-2X, 2 mike input pre-amplifier plugs is directly to the PA55N 50 watt booster amplifier. Allows use of 2 microphones, either crystal or dynamic and one low level input. Furnished with 4 ft. connecting cable and plug for remote control of the 50 watt booster. Chassis size, 5¾" x 3½" x 2½". Model PR-2X, Sale price, $12.95.

10" PM SPEAKER AND LEATHERETTE BAFFLE

Now, buy a full 10" PM speaker with Alnico V magnet with our top quality 10" leatherette wall baffle, both for only $5.49. Baffle is finest lock joint construction with rounded corners, quality covering and plastic grill cloth. Stock No. 10RN, 10" speaker and baffle, $5.49 each, 2 for $10.00.

12" PM speaker with same quality 12" wall baffle, only $7.49 each, 2 for $14.00.

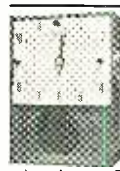
BOTH FOR $5.49

2 for $10.00

MINIATURE BROADCASTING STATION FOR THE HOME

NEW 1955 MODEL WITH CRYSTAL MIKE $9.95

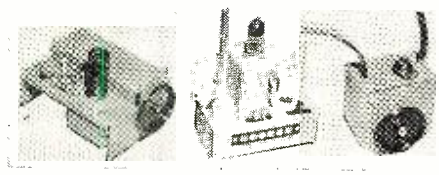
Sensational new model MCL-E3 miniature broadcasting station for microphone and phonograph. Can be received on any broadcast radio in the home. No wires to connect, tunes in just like a radio station. Has input jacks for crystal mike or record player. Complete with 12K8 and 70L7 tubes and instructions. Operates on 110 volts AC. Simple to operate; one control fades from microphone to record. Frequency can be adjusted so as not to interfere with local radio stations. Miniature broadcasting station, complete with crystal hand mike and instructions. Ship. wt. 4 lbs. Net price $9.95.



6" SESSIONS CLOCK-TIMER

With Plastic Cabinet $3.95

6" Sessions Clock-Timer in plastic case 7" x 9⅝" tall, 3" deep. Was intended for a kitchen clock radio. Lower part of case was used for a small radio chassis. Lower portion has a usable space of 6¾" x 4" high and 2⅜" deep with 3" diameter hole in front. Many ways this attractive clock and cabinet could be used, such as mounting a small bell below the clock for use as a kitchen clock and timer. Clock has sweep second hand and 15 amp. 125 volt switch to turn on appliances at any pre-set time. Case available in Ivory, Green or Yellow. Stock No. MCT-63, Sessions Clock-Timer with case of your color choice. Sale price only $3.95.



UHF CONVERTER TUNERS $2.95

3 FOR $7.50

Take your choice of any of these three UHF converter-tuners at $2.95 each, 3 for $7.50. (1) Mallory inducto-tuner with 6AF4 and 1N72 diode. This is a complete UHF osc-tuner similar to the one used by Mallory in a converter and by many set manufacturers in their UHF TV sets. (2) CBS-Columbia single channel UHF converter intended for use in UH11 and UH12 CBS TV sets. Complete with 6AF4 tube. (3) Small compact UHF converter tuning assembly with 6AF4 tube and diode. Many applications for this in UHF. Your choice of any of these for only $2.95 each, or 3 assorted for $7.50.

FAMOUS STANDARD COIL CASCODE TUNERS

SALE PRICE $12.95 2 FOR $25.00

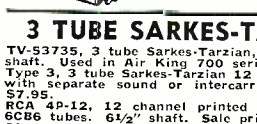
TV-2000 series Standard Coil cascode tuners complete with 6J6 and 6BK7 or 6BQ7 tubes. Thousands of TV sets use this famous tuner. Tunes 12 channels (2 thru 13). For 21 mc I.F. circuit. This tuner will give 2 to 1 better reception than the old pentode type. Many servicemen replace all older tuners with this cascode model. Available with either 2⅞" or 4¼" shaft length. A tremendous purchase makes our low $12.95 price possible. Specify shaft length desired. Stock No. TV-2000-3. Sale price $12.95 each, 2 for $25.00.

No. TV-4001-7, 41 mc Standard Coil cascode 12 channel tuner with 13th position for use with separate UHF tuner. 6¾" shaft. With tubes 6BQ7 and 6J6. Used in Sentinel, MW, Arvin, etc. Sale price, $12.95.

STANDARD COIL PENTODE TV TUNERS $9.95

SC-947 Standard Coil Pentode 12 channel tuner, as used by Emerson 650D, 655, etc. Fine tuning shaft insulated from ground. Filaments shunted with resistor for .6 amp drain. 2¼" shaft. With tubes 6BC5 and 6J6. Sale price, $9.95.
SC-948 Standard Coil Pentode 12 channel tuner with 6BC5 or 6AG5 and 6J6 tubes. Millions of TV sets now in use have this tuner. 1¾", 2⅞", 3", 4" or 5" shaft length. You can replace that old tuner cheaper than it can be repaired. Sale price, $9.95.

Matching knobs for Standard Coil tuners. Set No. SCK-2 for fine tuning and channel selector. Set VCK-2, matching volume and contrast knobs. Either set only 59¢ a pair.



TWO-TUBE SARKES-TARZIAN TV TUNER $8.95 WITH TUBES

New 2 tube Sarkes-Tarzian No. TT-3A, 12 channel TV tuner. 21-25 mc. Popular in many makes. Also, ideal for general replacement use. Has 6J6 and 6BC5 tubes. Used in CBS, Arvin, Crosley F17TOLBU, TOLH, TOLU, F21CDLBH, etc. Also, ideal for general replacement use. A good replacement for one tube tuners. 3⅛" shaft. No. TT-3A, Sale price, $8.95. Takes SCK-2 knob set described at left.

3 TUBE SARKES-TARZIAN, RCA, GEN'L. INST.

TV-53735, 3 tube Sarkes-Tarzian, 12 channel tuner, with 2-6AG5 and 6C4 tubes. 3" shaft. Used in Air King 700 series. Sale price, $7.95.
Type 3, 3 tube Sarkes-Tarzian 12 channel tuner with 6C4, 6BH6 and 6AG5 tubes. Use with separate sound or intercarrier. Has converter coil. 2⅞" shaft. Sale price, $7.95.
RCA 4P-12, 12 channel printed circuit tuner used in Hallicrafters. With 6J6 and 6CB6 tubes. 6½" shaft. Sale price, $9.95.
GI-44 General Inst. 12 channel tuner with 6BC5, 6AG5 and 6J6 tubes. 5" shaft. 21 mc I.F. Sale price only $4.95.

TUNERS FOR EXPERIMENTERS, BUILDERS $2.95

Bargain priced tuners, less tubes for the builders and experimenters. Ideal for building a field strength meter, etc. Type 4 Sarkes-Tarzian, has screw driver slot fine tuning instead of concentric shaft, $2.95 less tubes.
RCA-13X, 3 tube RCA 201E1, removed from sets may need repair. $2.95 less tubes.
GI-13X, 3 tube Gen'l. Inst. 12 ch. tuner. Removed from sets, $2.95 less tubes.

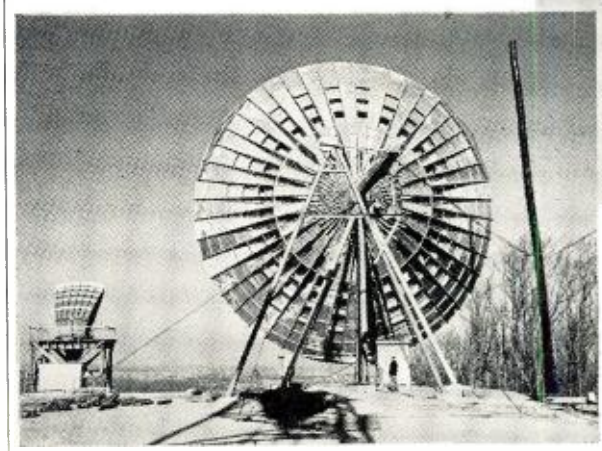
McGEE RADIO COMPANY

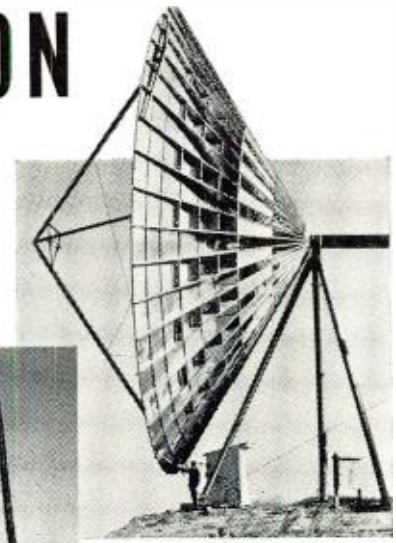
PRICES F.O.B. KANSAS CITY SEND 25% OR FULL REMITTANCE WITH ORDER. BAL. SENT C.O.D.

OUR NEW ADDRESS IS 1903 McGEE ST., KANSAS CITY, MISSOURI

"OVER-THE-HORIZON" TRANSMISSION

Direct TV transmission through space at distances up to 200 mi. is now possible without relays.





Side and rear views of the new 60-foot experimental antenna being used by Bell Labs in making its "over-the-horizon" transmission tests. The small scoop-shaped object at left in photo at left is one of the conventional antennas for line-of-sight systems.

THE direct transmission of television signals for distances up to 200 miles, without relay stations and at ultra-high frequencies, has been accomplished by the *Bell Telephone Laboratories* and the Massachusetts Institute of Technology.

The new technique is an extension of the transmission methods recently applied to the continental defense system.

The principal virtue of the new "over-the-horizon" transmission is that longer communications bridges are possible over water and rugged terrain. In the present microwave relay network across the United States, relay stations are 30 miles apart.

For many years, line-of-sight transmission between antennas placed on towers on the horizon was thought to be the only practical means of transmitting by radio the wide bands needed for television and multi-channel telephone service.

This has now been disproved after years of research at M.I.T. and *Bell Labs*. The *Bell* research stemmed from the *Laboratories'* success with transcontinental microwave systems for carrying telephone conversations, radio and television programs from coast-to-coast and their continued interest in radio propagation. The M.I.T. interest was stimulated by work for the Government in radar and overseas broadcasting.

Scientists knew that ultra-high frequencies traveled over-the-horizon under certain conditions but believed them to be too weak and undependable for practical day-in-and-day-out applications.

In the course of investigating occasional interference attributed to these waves, however, the scientists discovered that many actually overshot the relay towers they were aimed at and arrived at farther points with remarkable consistency.

The next step was to provide reliable long distance transmission over-the-horizon. M.I.T. and *Bell* engineers did this by erecting larger antennas and using higher power than is employed in conventional microwave systems. Thus, they put to use the weaker signals that drop off from a straight radio beam beyond the horizon and are reflected or scattered to distant points by the atmosphere.

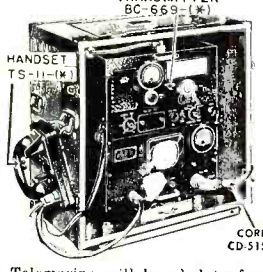
In order to make use of over-the-horizon transmission, 10 kw. transmitters and 60-foot diameter antennas are being used. This is 20,000 times the power and 30 times the antenna area used in the present transcontinental system. It was found necessary to employ the lower frequencies in the u.h.f. band to develop, with available equipment, sufficient power to attain a satisfactory degree of reliability.

The scientists emphasize that this success with over-the-horizon transmission will probably result in a supplement to, rather than a replacement of the line-of-sight radio relay systems presently in use.

The new technique, unlike ionospheric scatter, provides signals that are useful for the wide bandwidths required for TV transmission. —30—

REAL BARGAINS IN BEST ELECTRONIC SURPLUS

45W 6-CHANNEL RADIO TELEPHONE

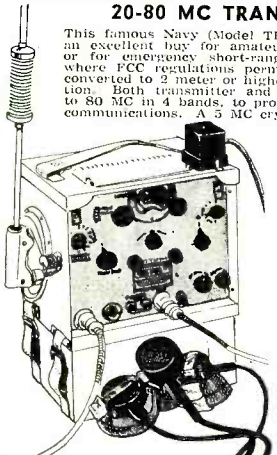


THE BIGGEST BARGAIN IN PLEASURE OR FISHING BOAT RADIOTELEPHONES!! LAST CHANCE to get a sensational value in a big-power ship-to-shore Radiotelephone. This Transmitter-Receiver (BC-669, part of SCR-543) is beautifully and ruggedly built. Designed for rough military service and engineered for maximum efficiency, it will provide trouble-free long-range communications from boat, vehicle, portable or fixed station installations. Both Transmitter and Receiver operate in the frequency range of 1680 to 4450 KC, and both are **crystal-controlled on all six channels** in this range. Manual tuning of the receiver is also provided. Power Output (Phone) is rated nominally at 45 watts.

Transmitter operation is performed with a minimum of controls, after installation adjustments have been made, consisting of: ON-OFF Power Switch, CHANNEL SELECTOR Switch to proper position, and ANTENNA TUNING Control rotated for maximum indication in RF Meter. Furnished are instructions and drawing for circuit modification in anticipation of new FCC regulations concerning harmonic suppression of transmitters operating in the 2 and 3 MC marine band. Operation of the 45-Watt Radiotelephone may be from 110 V. AC, 110 V. DC, 32 V. DC, 24 V. DC, or 12 V. DC. Complete constructional data and diagrams are furnished for building any of the above power supplies at minimum cost. For those who prefer to purchase ready manufactured power supplies, Telemarine will be glad to furnish quotations for any of the above voltage inputs. Each set is supplied with 12 crystals (6 for X-mit, 6 for receive) for operating on 1746, 2082, 2280, 2340, 3422.5 and 4255 KC. Receiving crystals differ by 385 KC (IF frequency). Most of these crystals can be reground to marine band frequencies. Receiver uses high-efficiency 10 Tube Superhet circuit with RF Stage for maximum selectivity, built-in loudspeaker. Static Filter (Noise Eliminator) Circuit with Switch, and RF Gain Control. Transmitter uses 8 Tubes (2-807's in Final) with 100% Plate Modulation, and Metering Switch with multi-range milliameter for instant checking of any part of transmitting circuit.

45-WATT RADIOTELEPHONE (BC-669A, B, or C Models), complete with all tubes, crystals (as specified), Inst. Book, Connecting Cord CD-515 (to Power Supply), Modification and Power Supply Constructional Data. **USED, GOOD CONDITION.** Shpg. wt. 185 lbs.
EACH **$99.50**
SAME AS ABOVE, NEW UNUSED CONDITION each **$139.50**
MODELS BC-669 D or E, Same as Above, but provides also CW (telegraphy) transmission and reception (incorp. BFO). **NEW, EACH** **$169.50**
TS-11 HANDSET, with appropriate plug connector. **EACH** **$14.50**
CUSTOM BUILT 12 V. DC POWER SUPPLY FOR ABOVE. EACH **$125.00**
PE-110 A, B, or C, 110 V. AC POWER SUPPLY EACH **$89.50**
PE-110 D, 110 V. AC POWER SUPPLY. EACH **$99.50**

20-80 MC TRANSCEIVER



This famous Navy (Model TBY) Walky-Talky is an excellent buy for amateurs, experimenters, or for emergency short-range communications where FCC regulations permit. Can be easily converted to 2 meter or higher frequency operation. Both transmitter and receiver cover 20 to 80 MC in 4 bands, to provide voice or MCW communications. A 5 MC crystal calibrator circuit is incorporated, to check and maintain frequency, which is ideal for checking other transmitters and receivers. Transmitter is modulated oscillator type, using a 958A acorn tube (plus 1-1E7 modulator tube, driven by a type 30 amplifier), and receiver is superregenerative using another 958A acorn detector with a 959 acorn as an RF amplifier to provide additional sensitivity, selectivity and minimized radiations when receiving. Operation is either from a battery pack which supplies 150 volts "B" voltage, 3.0 volts (with tap at 1.5 V.) "A" voltage, and −7.5 volts "C" bias voltage; or from a vibrator pack which will supply all of the above voltages when operated from a miniature 4 V. Storage Battery. All units are clean, excellent condition.

TBY-PORTABLE TRANSCEIVER, only: Includes tubes, Canvas Carrying Case and Schematic Diagram. Shpg. Wt. 25 lbs. **EACH** **$29.95**
4 V. VIBRATOR PACK, for above. Shpg. Wt. 7 lbs. **EACH** **$8.95**
MICROPHONE & HEADSET, with appropriate Plug Connectors. Shpg. Wt. 5 lbs. **PER SET** **$9.95**
INSTRUCTION MANUAL. Complete original technical manual, sold only if Transceiver is ordered. **$3.75**
COMPLETE TBY WALKY-TALKY. All above items, plus antenna sections, base insulator, etc., in chest-type carrying case, ready for operation except 4 V. Storage Battery. Shpg. Wt. 45 lbs. **PER COMPLETE SET** .. **$49.50**

SELECTIVE RINGER for MOBILE or SHIP-TO-SHORE RADIOTELEPHONES

Permits Phone Operator to call your Radiotelephone exclusively, when operator has a call for you, by ringing a bell or lighting a light. Designed & Mfd. by Western Electric, MODEL 107A, modern, compact and efficient. Can be attached to any receiver, complete Instruction Book supplied. Dim.: 15⅞" long, 8½" high, 5⅛" wide. Shpg. Wt. 25 lbs. **NEW UNITS.** Reg. value $245.00 each.
OUR LOW PRICE— EACH **$85.00**

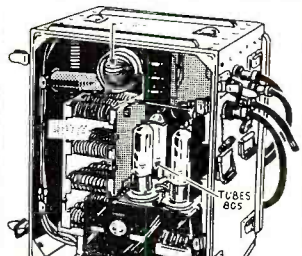
INFRA-RED IMAGE "SNOOPERSCOPE" TUBE EXTRA-SPECIAL ! !

We've sold thousands of them to Labs, experimenters, Industrials, studios, etc. By using Infra-Red rays, this tube enables you to see in the dark. No scanning, no amplifiers, just a high-voltage power supply is all you need with this tube. Shows image in greenish-white on 1⅜" screen. For night photography, signalling, snooper or sniper scopes, underwater detectors, etc. British mnfr. SOLD IN LOTS OF 6 ONLY! Literature and diagrams furnished with each sale. Shpg. wt. 2 lbs.

Slashed to 3 for $10.00

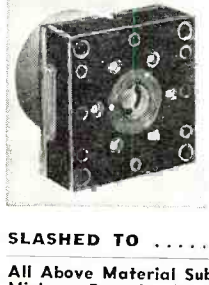
FRONT-END LENS, for Infra-Red Tube.
Bausch & Lomb ..... Ea. **$15.00**
Plain, Mounted Type ..... Ea. **7.00**

600 W. A.F. POWER AMPLIFIER



Designed by Bell Telephone Laboratories, ruggedly constructed 600 Watt Audio Power Amplifier. Ideal for use in airports, shipyards, or wherever high intensity sound may be required. Excellent for conversion to Modulator Unit for modulating 1 KW transmitters. Comprises push-pull audio power stage utilizing 4 —805 power triodes in push-pull parallel, with built-in motor blower for cooling. High voltage power supply uses selenium rectifiers, no tubes. Requires 40-60 watt pre-amplifier to drive to full capacity. Input impedance 250/500 ohms, output impedance 13/6.5 ohms (to speakers). Operates from 115 or 230 Volts, 3 phase 50/60 cycles AC. Dimensions of wooden chest 24⅝"x28⅞"x21⅛". Supplied with tubes, connecting cable, schematic diagram, etc. Shipping weight 290 lbs.
PRICE EACH, SLASHED TO **$169.50**

W.E. Pre-Amplifier for above, 60 W. output. Dim: 24⅛"x22⅝"x18⅛". Shipping weight, complete with tubes 190 lbs.
PRICE, EACH **$119.50**



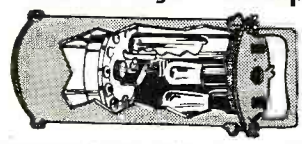
600 W. LOUDSPEAKER designed for use with above Amplifier, consists of two 6-unit sections which bolt together to form 12-speaker unit shown. Dotted lines show how wooden baffle extensions may be added for improved low-frequency response. Dim. of 6-speaker section 29½"L x 15⅝"H x 21"D. All steel construction. Uses loudspeaker units illustrated below. UNUSED. Shpg. Wt. per 6-speaker section 225 lbs. **PRICE: PER 6-Speaker section, $75.00.**

Western Electric Speaker Units, for horn or baffleboard mtg. Shock and blast proof diaphragm, will handle up to 60 watts. Response to 7,000 cps, favoring high freq. Impedance 13 ohms. Dim.: 6" x 6" x 4½" deep. Throat opening — 1⅜" dia. Alnico 5 slug wt. 6 lbs. Shpg. wt. 20 lbs.
SLASHED TO ..... **$11.95 EACH**

All Above Material Subject to Prior Sale. 25% Minimum Deposit with All C.O.D.'s. Min. Order —$5.00. All Prices F.O.B. Our Address.

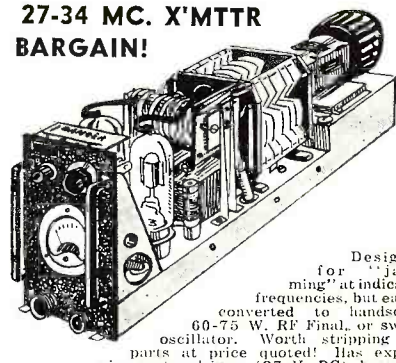
— TELEMARINE — COMMUNICATIONS CO.
3030 W. 21st Street, Brooklyn 24, N. Y.
(Coney Island)
Cable Address: Telemarine N. Y.
Phone: ES 2-4300

CONDENSER MICROPHONE With 2-Stage Pre-Amp.



Real, Precision quality construction, double Helmholtz Resonator type, with combination microphone and amplifier built-in cylindrical brass case 16 x 6 ins. Uses types 30 and 32 tubes in amplifier. Employs acoustical low-pass filter plugs (removable) for 5-25 cycle response; removing plugs (threaded) and venting cylinder case will result in high-quality, wide-range studio-type microphone. As is, excellent for vibration testing, percussion noises, shock sounds, oil exploration work. Original use—Sound (Artillery) Ranging Eqpt. Model T-21/GR-3-C. NEW UNITS. Shpg. wt. 25 lbs.
SLASHED TO ..... **$11.95 EACH**

27-34 MC. X'MTTR BARGAIN!



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D.C. VOLTS: 0 to 7.5/15/75/150/750/1,500/7,500 Volts

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OUTPUT VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts

D.C. CURRENT: 0 to 1.5/15/150 Ma. 0 to 1.5/15 Amperes

RESISTANCE: 0 to 1,000/100,000 Ohms 0 to 10 Megohms

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REACTANCE: 50 to 2,500 Ohms, 2,500 Ohms to 2.5 Megohms

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DECIBELS: —6 to +18 +14 to +38 +34 to +58

ADDED FEATURE:

Built-in ISOLATION TRANSFORMER reduces possibility of burning out meter through misuse.

The Model 670-A comes housed in a rugged, crackle-finished steel cabinet complete with test leads and operating instructions.

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A versatile all-inclusive GENERATOR which provides ALL the outputs for servicing:

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Superior's new Model TV-11

UBE ES ER

SPECIFICATIONS:

★ Tests all tubes including 4, 5, 6, 7, Octal, Lock-in, Peanut, Bantam, Hearing Aid, Thyratron, Miniatures, Sub-Miniatures, Novals, Sub-minars, Proximity fuse types, etc.

★ Uses the new self-cleaning Lever Action Switches for individual element testing. Because *all elements are numbered according to pin-number in the RMA base numbering system*, the user can instantly identify which element is under test. Tubes having tapped filaments and tubes with filaments terminating in more than one pin are truly tested with the Model TV-11 as any of the pins may be placed in the neutral position when necessary.

★ The Model TV-11 does not use any combination type sockets. Instead individual sockets are used for each type of tube. Thus *it is impossible to damage a tube by inserting it in the wrong socket.*

★ Free-moving built-in roll chart provides complete data for all tubes.

★ Newly designed Line Voltage Control compensates for variation of any Line Voltage between 105 Volts and 130 Volts.

★ NOISE TEST: Phono-jack on front panel for plugging in either phones or external amplifier will detect microphonic tubes or noise due to faulty elements and loose internal connections.

The model TV-11 operates on 105-130 Volt 60 Cycles A.C. Comes housed in a beautiful hand-rubbed oak cabinet complete with portable cover ..... **$47.50 NET**

EXTRA SERVICE—The Model TV-11 may be used as an extremely sensitive Condenser Leakage Checker. A relaxation type oscillator incorporated in this model will detect leakages even when the frequency is one per minute.

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C R.T. TUBE TESTER

★ A complete picture tube tester for little more than the price of a "make-shift" adapter!!

★ Tests *all* magnetically deflected tubes . . . in the set . . . out of the set . . . in the carton!!

The Model TV-40 is absolutely complete! Self-contained, including built-in power supply, it tests picture tubes in the only practical way to efficiently test such tubes; that is by the use of a separate instrument which is designed exclusively to test the ever increasing number of picture tubes!

EASY TO USE:

Simply insert line cord into any 110 volt A.C. outlet, then attach tester socket to tube base *(ion trap need not be on tube)*. Throw switch up for quality test . . . read direct on Good-Bad scale. Throw switch down for all leakage tests.

SPECIFICATIONS:

- Tests *all* magnetically deflected picture tubes from 7 inch to 30 inch types.
- Tests for quality by the well established emission method. All readings on "Good-Bad" scale.
- Tests for inter-element shorts and leakages up to 5 megohms.
- Tests for open elements.

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SHORT-CIRCUIT PROTECTION FOR METERS

By P. KOUSTAS
Tube Div., Radio Corporation of America

Three circuits which can be used to prevent damage to meters from short-circuit voltages as high as 5000 volts.

WHEN microammeters and low-range milliammeters are used in a supply delivering several hundred volts, they may be damaged beyond repair by sudden short circuits. In such applications, fuses and relays are not adequate protective devices. This article will describe three circuits which can be used to prevent damage to current meters of any range from short circuit voltages as high as 5000 volts.

Current meters are usually protected against overload by fuses or relays. These devices provide adequate protection in applications where the overload occurs rather slowly and is limited to about 200 per-cent of the normal load. However, when a microammeter or milliammeter is used in a supply delivering 1000 volts, an instantaneous short circuit may produce a peak current several hundred to several thousand times the normal meter rating, depending on the meter impedance, the regulation of the supply, and the size of the output filter capacitors. In such cases, the meter movement is usually destroyed before a fuse or relay can interrupt the circuit. An additional disadvantage of fuses is that they do not allow immediate resumption of current. Because relays which operate at low currents must have rather high resistance, they introduce other disadvantages when voltage regulation is of the utmost importance. In the case of low-range microammeters, no fuse or relay can perform satisfactorily.

The circuits to be described were developed originally to protect low-range microampere and milliampere meters in an unusual laboratory application. The first circuit, a comparatively simple device, is used when the meter range permits the use of a relay and the voltage drop across the relay is not objectionable. The second circuit, which is more complex, may be used for any current range and has negligible effect upon the supply with which it is used. The third circuit is a more complex version of the first, developed to accommodate voltages as high as 5 kilovolts.

Relay Circuit

When a short circuit occurs in the load fed from a well regulated supply, the full voltage of the supply is applied across the current meter for a few milliseconds. The time required for a relay to close, thus either short-circuiting the meter or shutting off the supply, usually is not short enough to prevent damage to the meter. The meter can be protected during this "delay" time, however, by the use of two thyratrons, as shown in Fig. 1. When a thyratron is placed across the meter, the surge voltage produced by the short circuit causes it to fire, and the relatively high impedance of the meter is shunted by the low impedance of the ionized thyratron for the time required for the relay to act. The use of two thyratrons of opposite polarity in parallel protects the meter against both positive and negative surges.

The *RCA*-2D21 thyratron ionizes in approximately 0.5 microsecond and requires an ionization voltage of about 35 volts. The surge voltage across the meter, therefore, is limited to 35 volts and the energy the meter movement must absorb is greatly decreased. When the meter is directly shunted with the thyratrons, it still absorbs enough energy to slam the pointer against the pin. However, the insertion of a small resistance, R, in series with the meter terminals limits the amount of energy that must be dissipated by the meter movement. The amount of resistance required is related inversely to the current range of the meter. The minimum value of R in ohms is equal to 2 divided by the meter scale in amperes; therefore, the resistance should be selected so that the full-scale meter rating times the resistance equals two volts or more. When the circuit shown

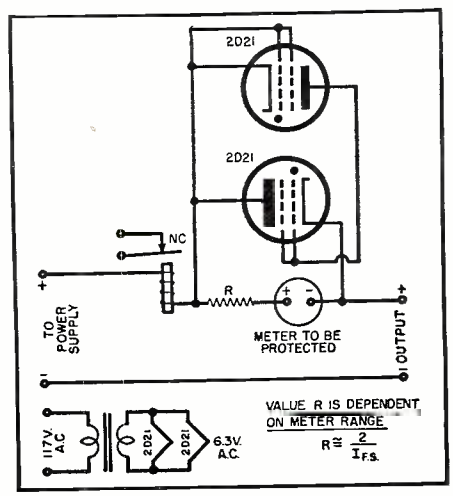
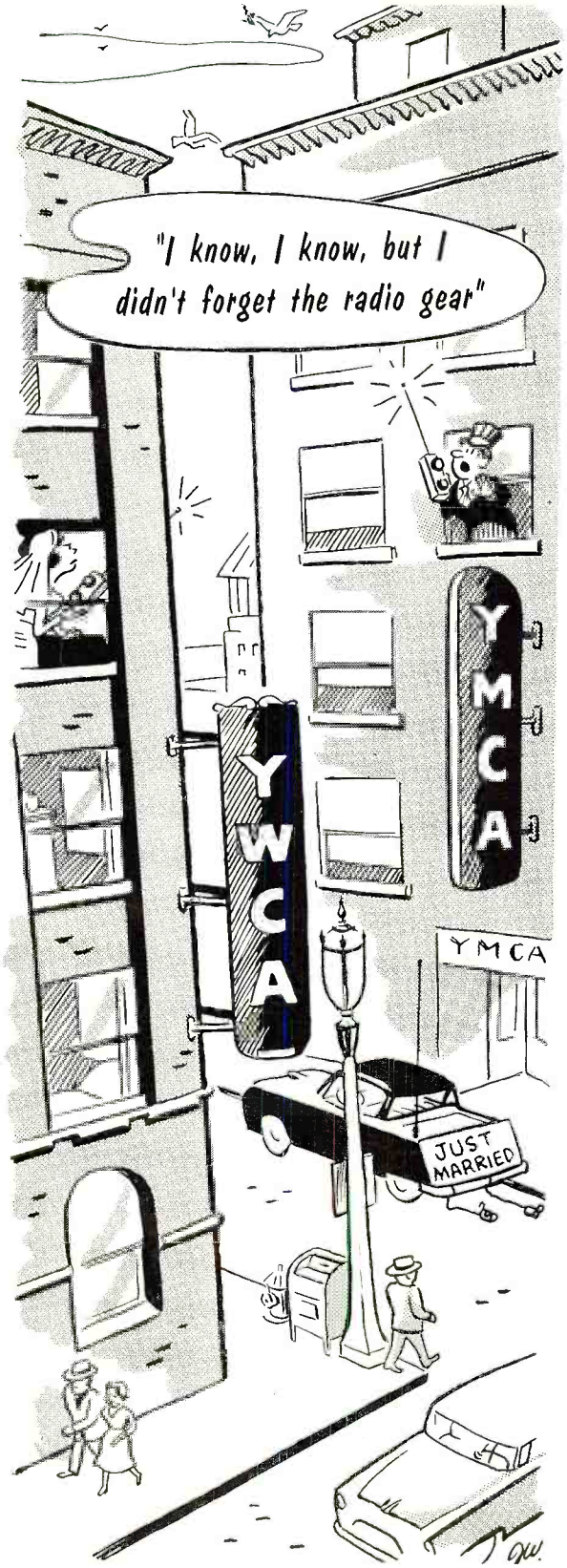


Fig. 1. A simple meter protective circuit. It is used for meter ranges above 5 ma.



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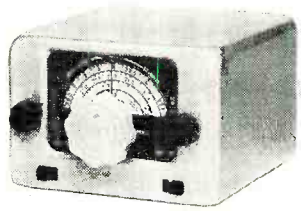

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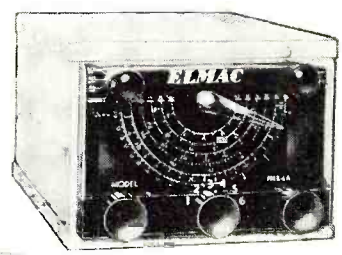

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in Fig. 1 is used with a *Potter & Brumfield* Type LM11 relay having a 5000-ohm coil, a 10 milliampere meter can be placed across an 800 volt power supply with no danger of damage to the meter from short circuits. When higher-current meters are used, the relay should be shunted with an appropriate resistance to protect against normal overloads.

Multi-Range Meters

Because almost all relays which operate at a current of a few milliamperes have a coil resistance of several thousand ohms, they produce a voltage drop which may be objectionable in applications where voltage regulation is of the utmost importance. Furthermore, relays may not operate with sufficient positive action at currents lower than 5 milliamperes.

The second protective circuit, shown in Fig. 2, operates by sampling the voltage drop across the meter terminals. This type of circuit is particularly useful for multi-range meters, in which the voltage across the meter terminals is independent of the current range used. This circuit can be used to protect meters of any current range, and introduces no appreciable loss in supply regulation.

In the circuit of Fig. 2, a d.c. amplifier tube amplifies the voltage across the meter terminals sufficiently to fire a thyratron. The thyratron then actuates a relay which turns off the supply primary and opens the plate circuit of the thyratron to stop conduction. Because the time cycle of this device is limited by the relay, the two thyratrons described previously are still required to protect the meter against instantaneous short circuits. The *RCA*-5691 shown in Fig. 2 is used in a balanced circuit to prevent line-voltage changes from affecting the triggering point. The 5691 is a long-life, ruggedized version of the 6SL7GT. After the balancing potentiometer is adjusted to provide equal voltages on both plates of the 5691, the sensitivity control is adjusted so that the 2D21 will fire at a current slightly higher than full scale of the current meter. The capacitor between the two plates of the amplifier tube prevents operation due to stray transient pickup.

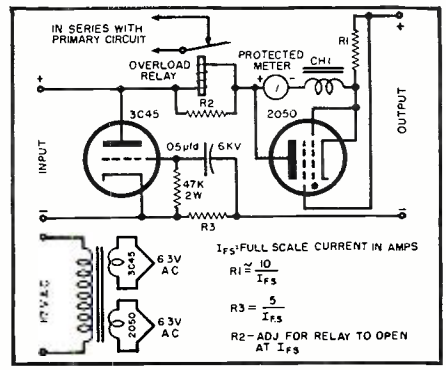


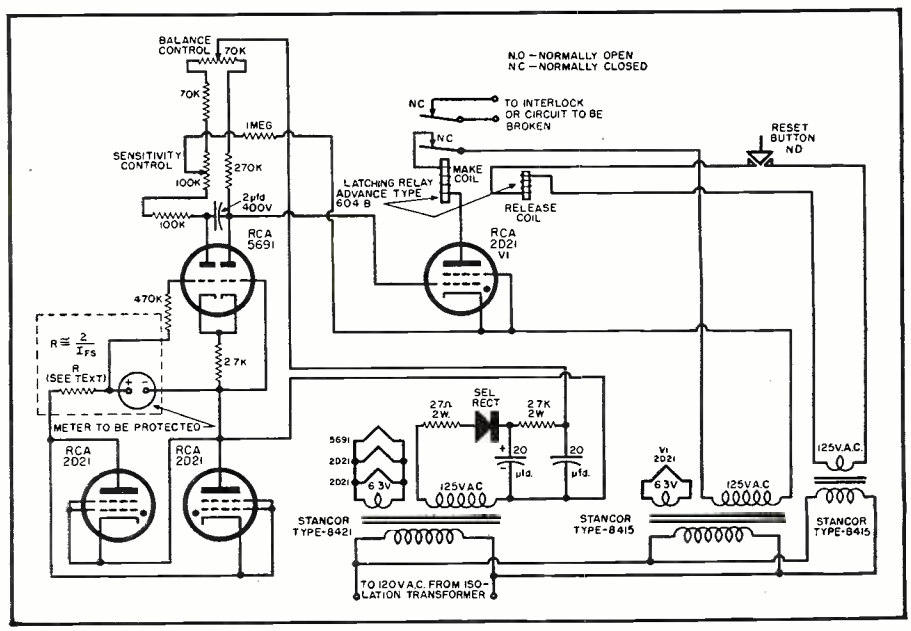
Fig. 3. High-voltage version of Fig. 1 unit.

When two or more units are used simultaneously, or when different units are at widely different potentials, a separate transformer is used to operate the release coil of the relay so that all units can be reset by a single-pole switch. The overload units must float at the same potential as the meter to be protected. The chassis of the protection unit should be insulated for this voltage, therefore, and an isolation transformer should be provided when the voltage between the meter and ground is larger than 500 volts. The circuit of Fig. 2 can be used to protect a 100 microampere meter placed across a 1600 volt supply.

High-Voltage Circuit

When the circuit of Fig. 1 was used to protect a milliammeter placed across a 5000 volt supply, the overload relay literally blew apart when the supply was short-circuited. Although the relay

Fig. 2. A "universal" meter protective circuit. It may be used for multi-range microammeters or milliampere meters of any type. See discussion.



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1L4	**.49**	**6AL5**	**.59**	**6Q7GT**	**.49**	**12J5GT**	**.45**	35C5	.39		
1LA4	.69	**6AQ5**	**.69**	**6S4A**	**.67**	**12K7G**	**.49**	**35L6GT**	**.71**		
1LA6	**.79**	**6AQ6**	**.49**	**6S7**	**.49**	12Q7GT	.59	**35W4**	**.46**		
1LC5	.69	**6AU6**	**.64**	**6SA7GT**	**.49**	12S8GT	.59	**35Z3**	**.49**		
1LC6	.59	**6AX4GT**	**.89**	6SB7Y	.99	**12SA7**	**.79**	**35Z5GT**	**.49**		
1LE3	.59	**6B4G**	**.79**	**6SF5GT**	**.49**	12SC7	.67	**41**	**.29**		
1LG5	**.69**	**6BA6**	**.69**	6SF7	.49	12SF5GT	.39	**43**	**.49**		
1LN5	.79	6BA7	.59	**6SG7GT**	**.49**	12SG7GT	.69	47	.39		
1P5GT	.69	6BC7	.79	6SH7	.49	12SH7	.69	**50B5**	**.72**		
1Q5GT	.89	**6BD5GT**	**.89**	**6SJ7**	**.49**	**12SK7GT**	**.49**	**50C5**	**.71**		
1R5	**.89**	**6BE6**	**.69**	**6SK7GT**	**.49**	**12SN7GT**	**.81**	50C6G	.68		

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device protected the meter, it was necessary to find some other means of quickly absorbing the energy stored in the supply filter.

The circuit shown in Fig. 3 is a high-voltage version of the relay-operated circuit of Fig. 1. In the high-voltage circuit, the hydrogen thyratron requires no bias supply for cut off, and it can dissipate large amounts of energy for very short periods. The positive pulse required to fire the 3C45 is developed across the resistor R_3 when a short circuit occurs. The value of R_3, which is dependent upon the normal operating current of the supply, is not critical and should be approximately equal to 5 divided by the full-scale current $I_{F.S.}$, in amperes.

The amount of series resistance required to prevent excessive "pointer slamming" at high voltages becomes too large for acceptable regulation. However, a conventional filter choke may be used in place of the resistor to present a high impedance to the short-circuit transient. The inductance of the choke is not critical. The current rating should, obviously, be the same as that of the supply. The 2050 thyratron shown in Fig. 3 performs the same function as the 2D21's in the first circuit described. However, a small amount of cathode bias is necessary in this circuit to prevent the normal IR drop through the choke from firing the thyratrons prematurely. It should be noted that separate heater transformers are required for the 3C45 and the 2050 because they are in opposite sides of the supply.

When the protective circuit shown in Fig. 3 is used, a direct short circuit can be thrown across a 5000 volt, 0.5 ampere supply with no resultant damage to a 1 milliampere meter.

The author wishes to express his thanks to Mr. L. J. Giacoletto of the *RCA Laboratories* in Princeton, N. J., and to Mr. John Malone of the Tube Division for their assistance. —30—

TECHNICIAN CLASS CHANGES

As a result of its consideration of petitions for rule making filed by James M. Price and Tom A. Walker, the Commission adopted the Notice of Proposed Rule Making in this proceeding. The Notice proposed amendment of Section 12.23(d) to permit operation by Technician Class amateur operators in all amateur frequency bands above 50 mc. which would have the effect of adding 50-54 mc. and the 144-148 mc. bands to the privileges presently available to the Technician Class license holders.

Because of opposition expressed by the ARRL to opening the 144 mc. band to this class of licensee, the FCC dismissed that portion of the petition but granted the other request as follows:

"Section 12.23(d) of Part 12, Rules Governing Amateur Radio Service, is amended as follows: (d) Technician Class. All authorized amateur privileges in the amateur frequency band 40 to 54 mc. and in the amateur frequency bands above 220 mc." Effective as of 3 a.m. EST, April 12, 1955. —30—

Tone Transmitter

(*Continued from page 63*)

of the chassis. Wire in the vibrator supply. The vibrator output should be about 295 volts, but is OK if it is over 250 volts.

Connect the metering circuit for the oscillator and power supply. Test the oscillator by tuning the plate capacitor, C_1, for a dip on the meter. (Use a non-metallic tuning stick.) It is very easy to tune to the second instead of the third harmonic in initial adjustment. Check the frequency with a wavemeter or a 27-mc. receiver. It may be necessary to spread or compress the turns of the plate coil, L_2, to obtain the proper oscillator range. If so, adjust the spacing of the coil until the meter dip occurs at about one-half the capacitor tuning range. No adjustment of the cathode tuning capacitor is necessary except to set it at full mesh. It could be replaced with a fixed value capacitor.

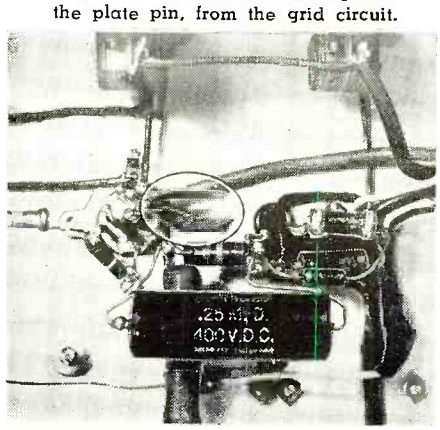
When the oscillator is operating correctly, wire the final amplifier, being certain to use the plate pin shield mentioned previously. Run a jumper wire to "B+" for testing as shown dotted in Fig. 2. Set the meter switch to the "Amp." position, and tune C_{10} for a dip.

The audio section chassis, containing V_3, V_4, and V_5, is made from a strip of aluminum, two inches by seven inches, with a flange on the side for mounting to the main chassis. Note the terminal strip provided on this subchassis for connecting the push-button leads (Fig. 4). The method of mounting the audio section provides shielding for these circuits.

After bolting the subchassis to the main chassis, connect the heaters of the audio section to the heater pin of V_2 on the socket. Remove the "B+" jumper and hook up the "B+" as shown in Fig. 2.

To test the completed unit, connect headphones to the voice coil of the oscillator transformer, T_1. Tones should be heard when push-buttons are depressed. To insure smooth ones, adjust each push-button so that its capacitor is grounded just before the resistor circuit is closed. —30—

Fig. 5. Bottom view of the final amplifier (V_2) socket showing the small strip of brass used to shield pin 5, the plate pin, from the grid circuit.



"OPERATION STARLING"

By MILTON H. CROTHERS

Asst. Prof., Electrical Engineering Dept., University of Illinois

Science devises a means of "giving the bird" to the flocks of pesky starlings that make urban living more difficult.

ONE HUNDRED starlings were introduced from Europe into Central Park in New York City in 1890-1891. It was expected that this bird would help in the control of insect pests. In the sixty odd years since that date this bird has swiftly grown in numbers and regions until today starlings are considered a first rate pest in most cities. Great flocks of these birds will return to the trees in a city at sundown where they "whitewash the streets, sidewalks, and cars" from their roost in trees. Many different methods have been suggested and applied to reduce the obnoxious effects of such starling invasions. The following account of one particular method should prove helpful in other cities where the birds require control.

Champaign and Urbana are the twin cities housing the University of Illinois and total about 70,000 persons. The rich farm land outside of these cities provides feeding grounds for large flocks of starlings which swarm into the many trees of the cities every evening in early fall. The numbers have increased yearly until 1954 when it became impossible to park cars outside in the evening or to even walk along the sidewalks. Mr. Fred Simmering, president of the Urbana Association of Commerce, started the drive against the birds at the request of residents in an area east of the campus. He called the Electrical Engineering Department of the University of Illinois for technical information and the following method of attack began.

A number of birds were collected and taken to the Speech Research Laboratory of the University where Mr. Virgil Krone made a recording of the cry of a starling in fear and fright. A natural cry was obtained since the starling was fighting with a blackbird, a natural enemy, and the starling was also restrained by a string on its leg. The recording was made with professional quality tape at 15 inches-per-second from the soundproof recording room of the Speech Research group. A slight boost was applied to the high frequency response to catch all important components of the bird's cry. The best section of the master copy was transferred into a loop copy which was then repeated until a six minute tape was formed. The low frequency range was cut with a special filter in the copy process to remove unwanted sounds of breathing, wing beats, and footsteps.

The copy tape was given to Mr. Larry Stewart, station manager of the local *CBS* radio station, WDWS. He arranged a free spot in the early evening for the broadcast of the tape. The local radio stations and newspapers carried advance notice of the special public service broadcast for several days before the broadcast time. The tape was played in its first length for one evening and several observers reported the actions of the birds. The public response in the region where the starlings were very troublesome was almost 100 per-cent. The author and Professor W. G. Albright toured the general region with the small *General Radio* Survey Meter; the level averaged over 70 db in the street, a figure slightly below that mentioned in the Penn State College tests (80 db in the tree level). A region of six by eight blocks had very good coverage.

It was estimated that an average of 20 radio receivers for each city block would give the minimum uniform level if these radio receivers were directed to the trees. Many of the houses in the zone are student rooming houses with a large number of radio receivers in each house; one lady reported 27 radios in operation at her house. It should be noted that sound truck systems would be of help in this plan but the use of a large number of household receivers is the key to uniform coverage of a large area. It was hoped that the regions outside the "Starling Park" would join the drive so the birds would fly back to the country. The relative cooperation seemed to be almost in direct proportion to the number of birds in the block; it should be noted that these regions received many birds during the program period and the birds remained in the new regions until winter chills came to drive the birds away for this year.

The observers reported the birds were greatly disturbed during the first test broadcast but the length of the period was too short for effective action. Dr. C. S. Kendeigh, ornithologist of the University, gave several helpful tips about bird habits and general help in the project. It was planned to play the cry for fifteen-minute periods on four evenings since the Penn State tests had indicated repeated applications were necessary for complete control.

These additional broadcasts were made in the following week during the time when the greatest number of persons would be at home. The series of four broadcasts seems to have driven the starlings from those areas where full public cooperation was given. The local newspapers ran several reports by residents: "—had thrown the birds into utter confusion," "For the last few nights I have not seen one starling," "It's like heaven now," "The broadcasts have completely removed the birds," "—made a very big difference."

A general survey of the two cities was made several weeks after the four broadcasts to check the lasting effect of the program. It was noted that a very few birds did return to the core area but in nowhere near the number roosting there before the broadcasts started. There were some birds in the regions where the public did not cooperate but these were judged to be no more than the number before the broadcasts. The South Campus region seemed to have an increase in its bird population; since there is no housing in that general region this condition is expected. Large flocks were also noted in North Champaign where scattered conditions may have prevented satisfactory coverage of some regions.

The following suggestions are offered to other cities which face the starling problem:

1. Obtain by some means a suitable tape or disc record of the fear-cry of the starling. Arrange to have your local broadcast station play this for fifteen minute periods on four evenings.

2. Papers and radio stations should carry a strong publicity advance on the program. It is very important that the public be aware of the need for full cooperation over all regions where the birds could roost. Explain that small radios will be quite directional over these high frequency sounds so table radios should be placed in open windows. Console radios will help to fill the general background and should be used.

3. Modulation should be full and radios should be turned to full levels during the program. Voice instructions may be given at background levels during the program. Warn the public to reduce the gain at the end of the program. Give pep-talks during the program so the public will check their neighbors.

4. Arrange for sound trucks to cover park regions and downtown regions where radios are not available. Some stores have p.a. systems for Christmas music which could be used for shopping regions. Auto radios will also help to cover those regions where residential radios are not available. We did not try auto horns or shotguns as additional noise makers because the fear-cry is considered to be most effective when used alone.

5. Follow up the program every day with reports from observers as to bird actions and numbers.

6. Arrange to protect animals which might become frightened by the strange cry; most family dogs do not seem to mind the sounds but there are reports of zoo animals showing great fear if the level is high. —30—

BELGIUM PLANS LOFTIEST TV ANTENNA STRUCTURE

By G. DE BRABANDER
Brussels, Belgium

THE Belgian Cabinet has recently agreed to give serious consideration to a project for the construction of the loftiest building in the world: a tower 1760 feet high. The idea for the project is credited to Professor G. Magnel of the Ghent University.

The tower will be composed of two main parts. The lower part will be a truncated cone, 1350 feet high, surmounted by a cylindrical cap 150 feet tall. It will be built of prestressed concrete and its summit will be 1500 feet above the level of the ground.

By way of comparison, the TV mast atop the Empire State Building in New York extends 222 feet above the main structure which measures 1250 feet from the street level.

The upper part, topping the first, is to be of light metallic construction, 500 feet high. It will have to bear the television antennas, which will extend to an altitude of 2100 feet. The Heysel, near Brussels, where it is proposed to build the tower, is about 210 feet above sea-level. The highest ground in Belgium is only 2000 feet above sea-level.

Professor G. Magnel has declared that the concrete cone will be based on nearly 1500 piles. Its diameter near the ground will measure 300 ft. and the thickness of its outer wall will not exceed 15 inches. The diameter of the cylindrical cap, a continuation of the cone, will measure 95 feet.

The interior of the building will take the form of a central tube connected with the outer wall by means of prefabricated cross-beams. The diameter at the narrowest part will be 33 ft. It will contain the elevator shafts.

There will be fifteen floors with plenty of space for rooms. Both the upper and lower parts of the tower will house the two Brussels television stations (French and Flemish) with their complete equipment, from studios to antennas, besides their clerical staffs. These studios will be several times larger than the cramped rooms which are at present at the disposal of the television services.

Three or four floors will house the new "Science-Palace," a school for radio-communications and several auditoriums.

The construction of the tower will take at least three years. If no major difficulties arise, building will start this year. Nearly eight hundred craftsmen, technicians, and specialists will be employed.

The cost of the fabric, it is estimated, will be nearly 70 million pounds ($196 million). The finished building will cost nearly as much again and the maintenance costs will run into thousands of pounds annually.

The real purpose of this gigantic building, in addition to serving as a carrier of the television antennas, is to provide an additional attraction for the Brussels International Exhibition, to be held in 1958. The inauguration of the tower is planned for Spring of that year.

It is expected that in 1958, 3 million visitors will call at the tower. All expenditures must be defrayed by admittance money, and when the Exhibition closes in 1959 it is hoped that visitors will still be numerous enough to pay the cost of upkeep.

—30—

HARMONIC CANCELER AMPLIFIER

Over-all view of the author's home-built canceler amplifier. It is a compact and inconspicuous unit.

By **PHILLIP W. LEE**

A novel method of canceling second-harmonic distortion from single-ended type amplifiers. Since the design applies solely to low-power units, its application is ideal for table model TV receivers and small radio sets.

THE HARMONIC canceler amplifier to be described in this article is designed especially for low-powered applications. You can enjoy good quality reproduction for little more than you would expect to pay for a simple single-ended audio amplifier. The harmonic canceler amplifier gives you top tone quality and excellent transient response. The frequency response is exceptionally good. With a high quality output transformer and a sacrifice of over-all gain, as was done in this design, the over-all response is flat from 50 cps to 20 kc.

The harmonic content of this amplifier is less than one per-cent at full output. It, just like push-pull amplifiers, cancels the even-ordered harmonics generated by the tubes. In push-pull we use two tubes in every stage, usually two triodes. The grid input signal voltages of the two tubes are equal in magnitude but opposite in phase. The out-of-phase grid driving voltages of the push-pull amplifier drive the two tubes oppositely and compensate for the curvature of the grid-voltage-plate-current curves. The push-pull amplifier could cancel most of the nonlinear distortion found in tubes operating alone. To reduce distortion to the smallest possible amount, balanced operation is necessary. Ordinarily, a push-pull amplifier will cost about three times as much as a simple single-ended audio amplifier. This is what keeps push-pull from being applied to countless radio and television sets.

The harmonic canceler amplifier, just as in a push-pull amplifier, uses the curvature of the dynamic curves (grid-voltage-plate-current curves) of two tubes to act against each other resulting in an over-all linear characteristic, only in the harmonic canceler the canceling of distortion occurs between stages in series instead of between tubes in parallel stages.

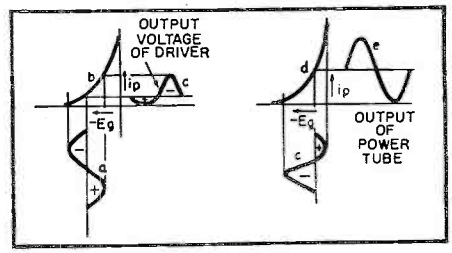
Theory of Operation

Fig. 1 is the graphical analysis of the harmonic canceler amplifier. In the graph, *a* is the signal input voltage of the driver tube, *b* is the dynamic curve of the driver, *c* is the output waveform of the driver, *d* is the dynamic curve of the power tube, and *e* is the output waveform of the power tube. After the signal voltage is amplified by the driver, it is distorted. This distorted, amplified signal voltage is then fed to the power tube. The power tube again distorts the signal voltage but in an opposite way. The distortion introduced by the driver is thus at least partially removed from the output. *The only limitations of fidelity within the amplifier are the odd harmonics and the correctness of balance.*

Circuit Consideration

As shown in Fig. 2, the input terminals of the harmonic canceler amplifier are shunted by a one megohm potentiometer. The plate load resistor is 10,000 ohms for the preamplifier. The reason for the relatively low value of this resistor is because if too high

Fig. 1. Graphical analysis of the harmonic canceler amplifier, explained in article.



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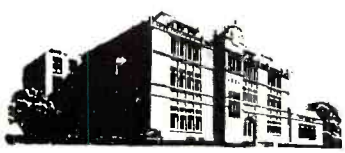

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a value is used, the reflected input capacitance of the preamplifier will be too large. In addition, the bandwidth will be greatly sacrificed by an increase in amplification.

The output from the preamplifier goes through a .05 μfd. capacitor to the grid of the other half of the 6SL7 which serves as the driver tube. The 15,000 ohm load resistor for the driver tube is specially evaluated to produce the right amount of distortion in the driver which acts against the non-linear distortion of the power tube. The load resistance of the triode-connected power tube (6L6) is 6000 ohms.

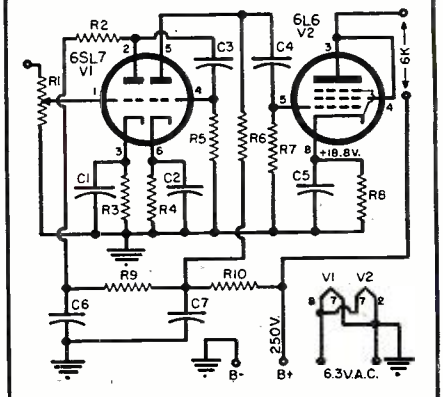
The cathode resistors of the power tube and the driver tube must be hand-picked for harmonic cancellation. Their magnitudes are quite critical, and must be precision units of the ±1% variety.

The transformer distortion may prove more troublesome in the harmonic canceler amplifier than in push-pull, because the harmonic canceler is single-ended. In push-pull, the d.c. supply current component for the plates has no effect upon the magnetic saturation of the output transformer because the d.c. magnetic fields of the plate windings cancel each other.

Fortunately, in low powered applications like home record players, radios, tape recorders, and television sets, the transformer distortion offers no particular problem if a good quality output transformer is used.

Although only one design of the harmonic canceler is described in detail, its ability to provide good quality reproduction makes it applicable to any audio unit. —30—

Fig. 2. Schematic diagram of the harmonic canceler amplifier. The output must match an impedance of 6000 ohms. Refer to text.



R1—1 megohm pot
R2—10,000 ohm, ½ w. res. ±10%
R3—1200 ohm, ½ w. res. ±10%
R4—1110 ohm, ½ w. res. ±1%
R5—150,000 ohm, ½ w. res. ±10%
R6—15,000 ohm, ½ w. res. ±1%
R7—470,000 ohm, ½ w. res. ±10%
R8—450 ohm, ½ w. res. ±1%
R9—20,000 ohm, ½ w. res.
R10—2000 ohm, ½ w. res.
C1—10 μfd., 25 v. elec. capacitor
C2—25 μfd., 25 v. elec. capacitor
C3, C4—.05 μfd., 400 v. capacitor
C5—50 μfd., 25 v. elec. capacitor
C6—1 μfd., 400 v. capacitor
C7—4 μfd., 400 v. elec. capacitor
V1—6SL7 tube
V2—6L6 tube

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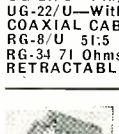

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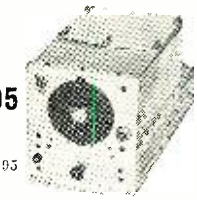
TU-7—4.5 to 6.2 MC	3.95	2.95
TU-8—6.2 to 7.7 MC	3.95	2.95
BC-306 Antenna Tuner	3.95	2.95
CABLES PL-64-61 or PL-59 Each End	Each:	2.75

BROADCAST BAND RECEIVER



NAVY/TYPE—520 to 1500 KC..NEW: **$24.95**

NAVY/TYPE REC.—1.5 to 3 MC. Less Tubes USED: $ 9.95

NAVY/TYPE REC.—6 to 9 MC. Less Tubes USED: 3.00

BC-455 REC.—6 to 9 MC. W/tubes.....Used: $1.95
R-28/ARC-5 REC.—100-156 MC. W/tubes..Used: 14.95
COMMAND TRANS.—2.1-3MC. Navy:U:$12.95;N: 16.95
COMMAND TRANS.—3-4 MC. Navy Type..Used: 18.95

TRANSFORMERS—115 V. 60 CYCLE PRI.:

600 VCT/100 MA—6.3 V/5 A.; 5 V/3 A. $4.95
650 VCT/50 MA—6.3 V/2.5 A; 6.3 V/.6 (Rect. 6x5) 1.95
350 VCT/40 MA—6.3 V/2.4 A; 6.3 V/.6 (Rect. 6x5) 1.75
2500 V/.015 A; 2.5 V/175 A; 6.3 V/.6A..... 5.95
1890 V/12.6 MA Tapped 2.5 V. 2 A. 5.95
1100 V/80 MA.; 7.5 VCT/3.25 A. 5.95
5 Volt CT-25 A; 10,000 V. Ins. Open Frame.....$7.95
9 Volt CT—35 Amp. Tapped 4.5 V..... 7.95
12 Volt—Two separate windings—4 Amp each.... 5.95
28 Volt 8 Amp Tapped 4 Volt..... 5.95
5 V/2 A; 5 V/2 A; 5 V/2 A; & 5 V/6 A. 2.95
600-0-600VAC—200 MA. 12.5 V. 2 A.; 12.5 V. @ 2 A.; 5 V. @ 3 A.—#H-108—Price..... 8.95
250-0-250 VAC—50 MA. 24 V. 1 A.; and 6.3 V. 1 A. #H-109—Price..... 3.95

CURRENT TRANSFORMER—Ratio 150 to 5; 25 to 60 cycle. West. Style 81R691.....$8.95
CONSTANT VOLTAGE REGULATOR—115 Volt 60 cycle, 80 VA. Sola #30726.....$12.95

Choke 12.5 Hy/100 MA. $1.95
Choke 15 Hy/165 MA., 125 Ohm..... 1.95
Choke 5 Hy/150 MA., 85 Ohm..... 1.50

6 VDC VIBRATOR POWER SUPPLY

RCA MJ-8—6 VDC input; output 275 VDC 80 MA w/024 Tube, 11 Ft. Batt. & Power Cable, Switch & Fused Line. 4½" x 4" x 6".....NEW: **$7.95**

METERS:

WESTON AC AMMETER:

(Pictured) In portable leather case, with Test Leads, 2½", 0-15 AC and 0-3 AC Scale..... **$5.95**

DC AMMETER HOYT: In portable metal case, with Test Leads, 4½", Fan, Mirrored Scale 0-15 ADC.....$4.95
0-3 RF AMMETER IS-128; 2½" Rd....NEW: 2.95
0-8 Amp RF w/Thermocouple IS-89; 2½" Rd... 4.95
0-15 AC-DC—2½" Rd.; IS-122..... 4.95
0-500 MA DC—2½" Rd.; IS-22..... 4.95

TG-34A KEYER
NEW — $16.95

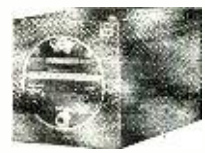
TG-34A KEYER—115 or 230 V. @ 50 to 60 cycles—an automatic unit for reproducing audible code practice signals previously recorded in ink on paper tape. By use of the self contained speaker, the unit will provide code practice signals to one or more persons—or provide a keying oscillator for use with a hand key. Unit is compact, in portable carrying case, and complete with tubes, photo cell, and operating manual. Size: 10-9/16" x 10½" x 15-13/16". Shipping weight: 45 lbs. NEW—While They Last— ONLY **$16.95**

TG-10 KEYER—Same function as TG-34A described above—only larger—Using 2/6N7, 2/6L6, 2/6SJ7, & 1/5U4G Tubes and 1/923 Photo Cell. Housed in standard Metal Cabinet, can be removed for 19" rack mtg. Size: 11" H x 24" W x 18½" D. Price—USED—TESTED.....Only **$17.95**

SELSYN

115 VOLT 60 CYCLE. Synchronous Transmitter C-78414. 5" x 3½". Long Leads w/Bracket Removed from New Equip. PAIR: **$15.00**

BEACON RECEIVER



BC-1206 CM—200-400 KC., Setchell Carlson, operates from 24-28 VDC, 5 Tubes, 135 KC IF —Size: 4" x 4" x 6". NEW: **$9.95**

BLOWERS:

12/24 VDC-AC CAST ALUMINUM BLOWER—100 CFM: 3" intake; 2" outlet. Shunt Motor 4" x 2", 3000 RPM @ 24 VDC..... **$5.95**

115 VAC 60 CYCLE SINGLE TYPE—100 CFM: 2¼" intake; 2" outlet. Complete Size: 5" x 6". No. 1C939..... **$8.95**

115 VAC 60 CYCLE DUAL TYPE—100 CFM: 4" intake; 2" Dis. Each Side. Complete Size: 8" x 6". No. 1C880..... **$13.95**

115 VAC 60 cycle COMPACT TYPE—108 CFM: Motor built inside squirrel cage; 4½" intake; 3⅜" x 3" Dis. Complete size: 4¼" W x 8⅜" H x 8⅛" D—No. 2C067 ..... **$14.50**

115 VAC 60 cycle FLANGE TYPE—140 CFM: 3½" intake; 2½" Dis. Complete size 7½" W x 7¼" H x 6¾" D—No. 1C807 ..... **$13.95**

115 VAC 60 cycle FLANGE TWIN—275 CFM: 4½" intake; 3¼" x 3" Dis. Complete size: 11¾" W x 8⅜" H x 8-1/16" D— No. 2C069 ..... **$21.95**

115 Volt 400 cycle—10 CFM. Eastern Air Devices Motor J31A—7200 RPM; 1/100 HP. L-R #2 Blower Assy. Overall Size: 4½" x 3½". No. 3110..... **$5.95**

115 VOLT 60 CYCLE BLOWERS:

6VDC SINGLE—100 CFM—No. 6100.....$4.95
6 VDC FLANGE—150 CFM—No. 6150..... 6.95
12 VDC SINGLE—10 CFM—Min.—No. 1210..... 7.95
24 VDC SINGLE—10 CFM—Min.—No. 2410.... 5.95
24 VDC DUAL—20 CFM.—Min.—No. 2420..... 7.95

MAGNETRON MAGNET

HEAVY DUTY PM MAGNET—Approx. 2000 Gauss—5½" x 7⅝" x 2⅜, 1½" gap. 10½ lbs. Removed from New Equip. **$5.95**

CLASSIFIED ITEMS:

BC-212G Amplifier—2 6C5.....N: $3.95; U: $1.95
BC-216A Amplifier—6F7 & 39/44.....U: 1.95
BC-229/429 REC. 2500-7700 KC., W Coils....U: 5.95
BC-230 TRANS. 2500-7700 KC., W/Coils....U: 8.95
BC-347 Amplifier—1/6E8G.....N: $3.95; U: 1.95
BC-357 Marker Beacon RECEIVER—75 MC. ..U: 3.95
BC-367 Amplifier—2 6V6GT.....N: $4.95; U: 3.95
BC-463 TRANS. & MODULATOR—67 to 74MC.U: 16.95
BC-654 TRANS. & RECVR—3800 to 5800 KC. U: 34.95
BC-709 Amplifier—Batt. Op.—1 tube: N:$3.95; U: 2.95
BC-745 TRANSCEIVER—3 to 6 MC. .....U: 14.95
BC-966 IFF SET—160-211 MC.—13 Tubes...U: 5.95
RI-ARR-1 RECEIVER—Conv. 2 or 6 Meters..N: 3.95
RT-7/APN-1 Altimeter .....U: 9.95
RT-34/APS-13 TRANSCEIVER—Less Tubes..U: 3.95
FL-8A Range Filter..U: $1.49; FL-5 Filter..U: 1.00
TS-9 Carbon Handset .. ..U: 3.95
TS-10 Sound Pwrd. Hndset or Hd & Chest Set U: 3.95
MP-22 MAST BASE—F/MS Sections.....N: 2.95
MP-S-33 MAST BASE—F/MS Sections.....N: 5.95
MP-37 MAST BASE F/MS Sections.....N: 6.95
MP-48 MAST BASE—F/MS Sections.....U: 5.95
MAST SECTIONS MS-49-50-51-52 or 53..Ea. N: .50
MAST SECTIONS MS-54-55 or 56.....Ea. N: .75
AB-15/GR MAST BASE—F/MS-S Sections...U: 5.95
MP-65 MAST BASE—F/MS-S Sections.....U: 6.95
MS-S MAST SECTIONS MS-116-117-118....N: .75

Address Dept. RN • $5.00 Order Minimum, & 25% Deposit on C.O.D.'s. • Prices are F.O.B., Lima, Ohio

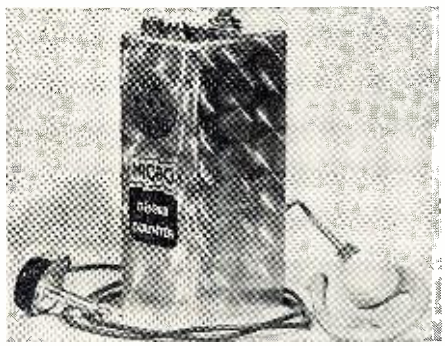
FAIR RADIO SALES
132 SOUTH MAIN ST. LIMA, OHIO

What's New in Radio

The products described in this column are for your convenience in keeping up-to-date on the new equipment being offered by manufacturers. For more complete information on any of these products, write direct to the company involved.

TRANSISTORIZED COUNTER

The Radiation Counter Division of *Transi-Mite Laboratory*, Manteo, N. C.,



has developed a small, transistorized Geiger counter that sells in the moderate price class.

The "Micro" requires just a single 1.5 volt mercury cell for operation. It measures 4½" tall and weighs a pound. The counter comes complete with a miniature earset, radioactive sample, pocket-size prospecting manual, and complete operating instructions.

A data sheet describing the new counter is available from the company on request.

"Q MULTIPLIER"

Of interest to the amateur fraternity is the announcement by *Central Electronics, Inc.*, 1247 W. Belmont Ave., Chicago 13, Ill., of the availability of its new Multiphase "Q" Multiplier.

The new unit is a tunable i.f. electronic filter that provides tremendous receiver selectivity for either peaking or rejecting an AM, c.w., or SSB signal. The selectivity is continuously variable from 60 cps to normal i.f. passband.

The new two-tube circuit employs a special very high "*Q*" pot core inductor

and the manufacturer claims up to 50 db attenuation of interferring carriers and the ability to reject undesired signals without affecting speech intelligibility.

The instrument is made in three different models. The Model AQ is for installation in the Model A sideband slicer and includes a new front panel and power cable to plug into the accessory socket. The Model DQ is a desk model which can be connected to any receiver having a 450-500 kc. i.f. frequency. The third model is the combination Model A sideband slicer and "Q" multiplier which has been designated as the Model B.

TINY ALLIGATOR CLIP

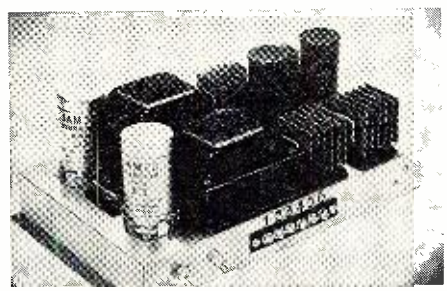
Mueller Electric Co., 1583H E. 31st St., Cleveland 14, Ohio, has developed a miniaturized alligator clip which it claims is the smallest ever made.

The new steel or solid copper clip is completely insulated by a vinyl plastisol sheath-type insulator. Designed for quick, temporary connections in miniaturized and subminiaturized equipment, the clips are adaptable to many uses.

A data sheet providing full details on the line is available on request.

MOBILE POWER SUPPLY

James Vibrapowr Company, 4036 N. Rockwell St., Chicago 18, Ill., is cur-



rently marketing a new mobile vibrator power supply, the Model C-1050.

The supply is intended primarily for amateur mobile installations but will have many other applications where high power is required for mobile equipment. The unit has a maximum power output of 95 watts at 450 volts. It is equipped with a low voltage transmitter and reserve voltage tap and has an incorporated receiver muting relay.

This unit will operate on either 6 or 12 volts by minor tap changes. The same standard heavy-duty, 4-prong vibrators are used for either input voltage. The supply is available in either wired or kit form.

5-INCH SCOPE

Hickok Electrical Instrument Company, 10524 Dupont Ave., Cleveland 8, Ohio, is in production on a new, wide-range 5-inch scope which has been especially designed for industrial electronic engineering applications.

The Model 770 offers a frequency range of d.c. to 2.5 mc. with the vertical amplifier bandwidth switch in the narrow position and from d.c. to 5 mc. in the wide position. Horizontal amplifier bandwidth is d.c. to 500 kc., the sweep circuit oscillator covers from 2 cycles to 30 kc., while the fixed sweep frequencies cover the band from 30 cycles to 7875 cycles.

The instrument features an illuminated, calibrated screen backed with a green filter for reducing incident illumination in the room.

For full specifications on the Model 770, write the company direct.

TRIO "99"

Trio Manufacturing Co. of Griggsville, Ill., has just introduced its "99" antenna which has been designed specifically for Channels 2-13.

The new unit uses two dual-purpose active elements, each consisting of three half-waves in-phase on the high channels and, at the same time, a single half-wave on the low channels. To this is added a combination of three parasitic elements on the low channels and five on the highs.

The manufacturer claims high forward gain and maximum side-rear rejection as a result of more critical element lengths and spacing. The "99" is constructed of high-strength *Alcoa* aluminum, is preassembled, and uses the company's "InstaLok" clamps for quick, easy, and positive installation.

WEATHERPROOF COATING

The TV Tower Division, *Kuehne Manufacturing Company,* Mattoon, Ill., has announced that its line of TV towers is now being produced with a durable zinc finish bonded to the steel by electroplating for a permanent, high-lustre finish. The towers are now said to be completely rustproof without painting. If, however, painting is desired to match exterior color schemes, the zinc finish provides a good base coat.

(*Continued on page* 104)

The design of the towers will continue to incorporate the firm's exclusive lateral load-bearing joints and the grid-around cross ties which permit the tower to stand free up to 50 feet in gales up to 80 m.p.h.

ELECTRONIC ORGAN KIT

A complete electronic organ in the form of build-it-yourself kits has been

introduced by *The Schober Organ Corporation,* 35 Dail St., New Hyde Park, N. Y.

The organ can be built by a complete novice, yet is a full concert instrument with two manuals, 32 pedals, 19 stops, and 6 couplers. suitable for use in the home, a church, or an auditorium.

Operation is completely electronic, with no moving parts except the keys and controls. Among the features which make construction simple and technical knowledge unnecessary are 130 printed circuits. Kits for the separate components, such as each of the 12 tone generators, or preamplifiers, stop filters, etc., may be purchased separately to make budgeting easy.

Console, keys, pedals, and bench are especially designed as fine furniture to lend a professional appearance to the completed instrument.

A booklet containing full data on this organ kit is available from the manufacturer on request.

RAYTRONIC "BEAMER"

Raytronic Laboratories, Inc., Cincinnati, 15, Ohio, has recently introduced its "Beamer" unit which is designed to positively check, by direct reading, the gas content of any picture tube.

The gas pressures in the picture tube are measured by using the picture tube as an ionization gauge and the "Beamer" as a source of control voltage and current indication.

Operation is straightforward and positive. Designed especially for service operators and technicians, this new instrument gives a positive picture of CR tube life.

SWEEP CIRCUIT ANALYZER

A new TV test instrument for color or monochrome, designed to trouble-shoot horizontal and vertical deflection circuits, has been introduced by *Winston Electronics, Inc.,* 4312 Main St.,

Philadelphia 27, Pa., as its Model 820 Dynamic Sweep Circuit Analyzer.

The unit provides 60 cycles of vertical saw-tooth, 15 kc. horizontal saw-

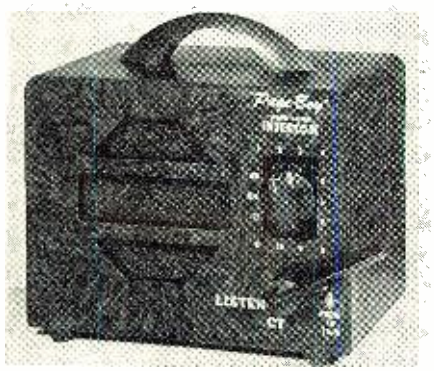
tooth, and deflection transformer drive for both vertical and horizontal sweep circuit troubleshooting by speedy signal substitution. In addition, the instrument provides a positive test for flyback transformers and yokes, using an oscillating neon indicator in conjunction with a d.c. amplifier, making the indicator more sensitive than a meter.

The instrument is housed in a portable blue-black case with blue-grey sloping front panel.

WIRELESS INTERCOM

Semco Electronics Corp., 17 Warren St., New York 7, N. Y., is marketing a wireless intercom under the tradename "Page Boy."

No installation is required. The units are designed to be simply plugged into the house wiring. The cabinets are made of sturdy Plaskon and have suf-



ficient weight to prevent sliding. The "press-to-talk" control can be manipulated with finger-tip pressure.

The intercom is currently available in mahogany and ivory finishes.

TUNING SLUG RETRIEVER

General Cement Mfg. Co., 919 Taylor Ave., Rockford, Ill., has come out with a new service tool for the technician.

The tuning slug retriever is available in two sizes, 12" and 15". It is designed to work on all *Standard Coil* tuners where it is used to recover tuning slugs on the oscillator coils of channel strips. They are also said to fit the new wide-slotted slug and deep-seated tuning units.

Each of the models has a precision-

made alloy blade and Tenite handle. In addition to slug retrieving, the tools can be used to reclaim screws and to start set screws in previously inaccessible spots.

INDUSTRIAL TV CAMERA

A new type of portable and streamlined industrial television camera chain, designed for simplicity of operation by non-technical personnel, has been introduced by *General Precision Laboratory* of Pleasantville, N. Y.

The new camera chain plugs into any standard 115 volt line, uses any

type of home receiver as a viewing monitor, and can be controlled and monitored from points up to 1000 feet from the pickup point.

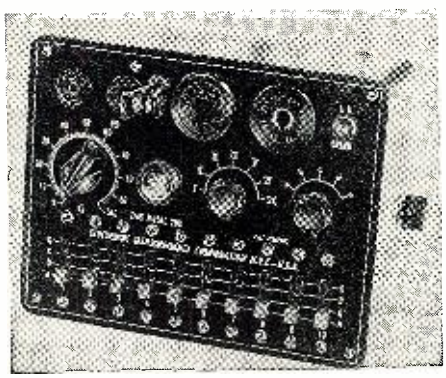
The camera is built around a "Staticon" tube, a pickup tube only 6" in length and 1" in diameter. The system is the standard 525 line, 60 fields interlaced. Lenses are 16 mm cine motion picture type.

The chain consists of two units—a 5-pound camera and a 26-pound unit housing all controls, power supply, and sync generator. Complete technical data on this device is available from the manufacturer on request.

EMC TUBE TESTER

Electronic Measurements Corporation of 280 Lafayette St., New York 12, N. Y., is in production on a low-cost tube tester, the Model 208.

The new tester will check all octal, loctal, miniature, and noval base tubes



for tube quality as well as shorts, leakages, continuity, or opens between any two elements of the tube irrespective of the location of the defect.

A flexible switching system assures

complete tube testing of all present and future tubes. Incorporated in the Model 208 is a visual line voltage check to insure accurate testing.

Individual sockets are furnished for each tube type to eliminate possible prong damage. To further lessen the chance of prong damage, all elements are numbered according to pin numbers in the RETMA base numbering system.

TV ANTENNA SWITCH

Superex Electronics Corporation, 4-6 Radford Place, Yonkers, N. Y., has

added the Model UV-1, u.h.f.-v.h.f. antenna switch to its line of TV accessories.

The Model UV-1 features silver-plated switch contacts, positive indexing, no measurable signal loss, and an attractive case with out-of-sight mounting brackets.

The new unit may be used for u.h.f.-v.h.f., v.h.f.-v.h.f., u.h.f.-u.h.f. antennas as well as for color.

GEIGER COUNTER KIT

Uranium Prospecting Equipment, 13833 San Antonio Drive, Norwalk, Calif., has developed a compact, low-cost Geiger counter kit which is being marketed as the Model 210.

The kit comes complete with all necessary parts including tubes, twin headset, batteries, choke, capacitors, resistors, switch, aluminum housing, punched chassis, carrying strap, and hardware. No drilling, machining, or painting is required. Only household handtools are needed to assemble the kit. Step-by-step assembly instructions are included.

For those who would rather buy a completed unit, a factory-wired version of the Model 210 is also available. Write the company for full details on either model.

NEW LIGHTHOUSE TUBE

The Tube Department of *General Electric Company,* Schenectady 5, N. Y., has developed a new lighthouse triode which operates up to 4000 mc.

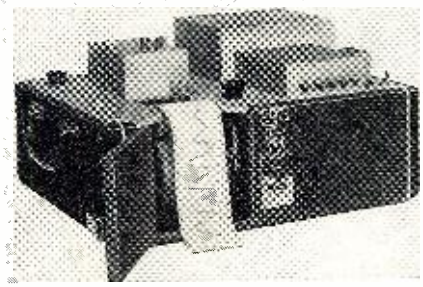
Designed for military and industrial c.w. and pulsed power applications, the new type GL-6442 measures only $2\frac{39}{64}$" high and $\frac{39}{64}$" in diameter exclusive of the grid flange. The tube is suitable for applications in beacons, communications, low-power radar, microwave relays, navigation, special test equipment, and telemetering.

A data sheet listing maximum ratings and typical operating characteristics is available from the company on request.

SLIDING-COIL RECORDER

Sound Apparatus Company, Sterling, N. J., has developed a new "Sliding-Coil Recorder" for electro-acoustical measurement applications.

The Model SL-2 records on a 2" wide chart and is a self-contained, compact portable instrument for both laboratory and field use. The device is particularly suited for measurements of reverberation, sound intensity, vibration, sound decay, and any impulse or phenomenon which can be converted into an electrical signal.



The recording scale function depends only on the taper of the input pot and this, in turn, permits a multiplicity of scale functions to be recorded.

Descriptive literature and technical data are available on request.

TRIPLETT V.O.M.

Triplett Electrical Instrument Co., Bluffton, Ohio, is now offering a new v.o.m., the Model 630-NA.

The unit incorporates six new features. It has meter protection against overload, 70 ranges, and frequency compensation up to 20 kc., providing accurate readings over the entire audio range.

Full details from the company. —30—

Spot Radio News
(*Continued from page* 18)

this beam post will supplement the short-range radio airways which criss-cross this country, Canada, and Mexico. Conventional radio ranges do not extend over the ocean, it was noted. And, in addition, jet planes flying at great speeds cannot take the time to follow short-range paths.

The station at Camden will supply information that will enable a pilot to get continuous indication of position at all times with respect to the ground station. For a jet plane traveling at 600 miles per hour, it was pointed out, such transmission would provide guidance for a flight of five hours.

The "Navarho" station will feed data to a pilot and tell him whether he is east, north, south, or west of the station and even how far he is from the transmitter. Knowing this and his destination, the pilot will be able to plot a direct course. In larger planes, com-

puters will do most of this plotting automatically.

The master timing unit for the station will be one of the most accurate timing devices in existence, with a required time stability of one part in one billion for twelve hours. Accordingly, a plane 1000 miles from the station will receive information accurate to within 10 miles in any direction.

If the station is a success, it will become the first in a world-wide chain of installations providing navigation aid to planes anywhere on the surface of the globe.

Currently, there are 60,000 flights a year over the ocean. Within four years, this total will jump to an estimated 90,000, underlining the need for accurate long-distance navigation aids, such as the Camden project.

ARDC HAS ALSO DISCLOSED that a transistorized digital computer has been developed for supersonic aircraft, known as "Tradic" (*TR*ansistor-*DI*gital-*C*omputer), the computer requires less than 100 watts to operate; this is one-twentieth of the power needed by comparable tube computers.

(A computer of this type might be likened to the mileage indicator of a car; it's a counting machine which clocks off one number after another. Each digit shifts when the number to the right of it passes nine. Actually these computers can perform only additions or subtractions, but they are able to multiply or divide by successive additions or subtractions. There is another type of computer, the analog, which like a speedometer represents speed in terms of the angle of the pointer on the dial. This computer gives results in terms of voltages, resistance, or rotations.)

This unusual device can do sixty-thousand additions or subtractions, or three thousand multiplications or divisions a second. A typical problem fed into the machine requires it to go through 250 different steps of computation. It can run through an entire problem of that complexity and provide an answer in about 15-thousandths of a second. The computer can handle, simultaneously, as many as thirteen 16-digit numbers.

Mathematical instructions are put into the unit by means of a plug-in unit, resembling a small breadboard. Plug-in units are set up beforehand with interconnecting wires to represent problems at hand. Numbers to be processed are put into the machine by means of toggle switches.

Answers to trigonometric problems appear on a scope, *via* a series of dots. These dots of light move so rapidly that they appear to draw geometric diagrams on the scope screen.

The unit contains nearly 800 transistors and 11,000 germanium diodes; the latter serve as the electronic equivalent of tiny one-way switches.

AT THE NAVAL RESEARCH LABORATORY in Washington, D. C., the highest gain antenna in the world to-

NEW TV GRANTS SINCE FREEZE LIFT

Continuing the listing of construction permits granted by FCC since lifting of freeze. Additional stations will be carried next month.

STATE	CITY	CALL	CHANNEL	FREQUENCY	POWER*
Alabama	Mobile	.....	5	76-82	100
Iowa	Des Moines	.....	8	180-186	316
Washington	Yakima	.....	23	524-530	21.9

NEW CALL LETTER ASSIGNMENTS

STATE	CITY	CALL	CHANNEL	FREQUENCY
Idaho	Lewiston	KLEW-TV	3	60-66
Louisiana	Shreveport	KTBS-TV	3	60-66
Missouri	St. Louis	KTVI	36	602-608
Pennsylvania	Sunbury	WKOK-TV	38	614-620

CALL LETTER CHANGES

Ohio	Lima	WIMA-TV (Formerly WLOK-TV)	73	824-830
Virginia	Petersburg	WVAA-TV (Formerly WPRG-TV)	8	180-186

*ERP=(effective radiated power, kw.) ..... Call letters to be announced

day is in operation. It's a 50-foot parabolic reflector built for operation at wavelengths as short as 8 mm.

Describing this huge dish at the recent IRE meeting in New York, D. L. Holzschuh, of *Collins Radio*, said that the antenna is assisting astronomers in their study of radiations from the sun, moon, and hot hydrogen regions of the galaxy.

The reflecting surface of the dish is composed of thirty sections of cast aluminum weighing a total of 30,000 pounds, and is supported by a circular-welded 2S aluminum girder weighing 16,000 pounds. The assembly is pivoted in altitude on roller bearings supported by a welded steel yoke; this is mounted on a standard hydraulically-driven twin five-inch gun mount that positions the dish in both azimuth and altitude. A steel operating link connects the rear of the gun mount slide with the dish-support ring to vary the altitude between limits of +95 degrees and −12 degrees. In all, the structure aggregates 75 tons.

Fabrication of the dish structure was carried on in a tent, out of doors, at Cedar Rapids, Iowa. Welding was of the inert-gas shield electric type with 2S aluminum wire 3/32 inch in diameter fed continuously into the arc and functioning as the negative electrode. A total of 150 pounds of wire was used with a total of 3000 cubic

The Remington Rand "Univac" in operation. The Central Computer is visible in the background while the Supervisory Control panel, which gives the operator a continuing picture of the operations of the computer, is in the foreground. The control printer, at the right behind the operator, is used for printing out spot results, or to permit the computer and the operator to communicate with each other. The mercury memory, in which all information being processed is stored for instantaneous access, is inside the Central Computer cabinet. At the right are the "Uniservos," high-speed, tape-handling mechanisms that feed information into the computer and take away the finished results. One reel of the "Univac" tape holds 1,500,000 alphabetic or numeric characters. Auxiliary tape equipment is not shown.

feet mixture of argon and helium. Direct current welding was performed at from 250 to 450 amperes.

The dish was shipped in four gondola cars to Washington. Reassembly was completed in six weeks and another five and a half months were spent in adjusting and checking.

The antenna has recently been used to locate heretofore-unknown radio stars at 10-cm and 3-cm wavelengths, to plot the temperature of the moon across its surface at 8.5-mm wavelength, and to study radiation from hot interstellar hydrogen gas at 21-cm wavelength.

FM's stock took quite a leap in the early Spring when the Commission authorized functional music and related services on both a simplex (for one year only) and multiplex basis.

FM broadcasters will receive a special *subsidiary communications authorization* if, in addition to providing a newly established minimum of 36 hours weekly of program service, they wish to simplex or multiplex functional music, news, time, weather, or related subsidiary program material to certain customers equipped with special receivers.

The FCC ruled that the supplementary program material would have to have a content of either an entertainment or informational nature, but could not compete with services now available through common carrier or other licensed channels, such as taxi dispatching or doctor paging.

THE FIRST OFFICIAL demixing move that would make a city all-v.h.f. or all-u.h.f. has been taken by the Commission. Notices of rule making were released for cities in Indiana, Connecticut, Wisconsin, and Illinois.

Evansville, Ind., and Peoria, Ill., are two of the cities involved. The Evansville situation is complex, because here the Commission will have to decide the fate of a single low-band station (channel 7) and three u.h.f. channels (50, 56, and 62). A similar situation obtains in Hartford, Conn., where one v.h.f. and two u.h.f. channels must be re-aligned. And in Madison, Wis., channels 3, 21, 27, and 33 have been thrown in the ring for a decision.

Station allocations continued to trickle and, as this column was being written, only those shown in the table on page 110 have the green light.

THE FATHER OF RADIO IN THE NAVY, Rear Admiral Stanford C. Hooper, is dead. Since the early days of World War I, the Admiral had been actually the Navy's top engineering specialist on radio communications. And, in addition, he had served as chief engineer of the Federal Radio Commission. His dynamic contributions to the military and commercial world played a significant role in communications progress. . . . . L. W.

The NARTB Curve

(*Continued from page 41*)

sponse will be obtained from the playback head and its amplifier. However, the NARTB standard calls for this compensation to be as shown in Fig. 6. Suppose we work backward and see what this means in terms of the signal on the tape. The 6 db curve would result in flat response. Application of the NARTB standard gives the curve in Fig. 7.

It will be seen that this curve agrees with the general approach discussed in the first part of this article. Thus, we have a standard based on the signal level recorded on a tape and expressed in terms of a calibrated playback system. The standard is based on the characteristics of tapes in general; and on the characteristics of program material. Also, the standard is expressed in terms of a 15 inch-per-second tape speed. However, there is nothing in the basic philosophy of the standard that is a function of the speed unless it is the overload characteristic of the tape. (Note that the calibrated head *gap loss correction* is a function of tape speed, but is outside the basic standard.) The standard also allows complete freedom to the recordist in choosing the type of bias, or amount of a.c. bias, or any other characteristic at the recording end of the system, as long as he is satisfied with the results he obtains in playing it back through the standard playback system.

There has been very little material published on the overload characteristics of tapes. It would be most useful to have definite data on this point, including the effect of different tape speeds, before future standards are set. It is quite possible that still more pre-emphasis could be safely used. The graphs in Figs. 1, 2, and 4 were purposely presented without db scales because exact data was lacking.

It should probably be added in closing that the standard established was the result of compromise between several companies engaged in producing professional recording equipment, and is more or less an average of the various values used by them before the standard was established. In the author's opinion it was a sound choice for professional recording. There may have been members who disagreed in principle, but who agreed in fact in order to attain a standard. It was most gratifying to the committee members to find their standards so quickly adopted by the industry.

It is to be hoped that the adoption of uniform standards for home-type recorders will be handled as expeditiously as the professional standards.

REFERENCES

1. Olson, H. F.: "Musical Engineering," McGraw-Hill Book Company, Chapters 6 and 9.
2. "Bell Laboratories Record," June 1934.

—30—

studying Fig. 6 patterns obtained and the corrections time the coupling or adjusted, it is necessary to C_{12} and C_{15} slightly for best on the scope.

When the desired response is obtained substitute the antenna for the 300-ohm load resistor. Remove the sweep generator and restore the amplifier for use with the exciter and perform any retuning necessary. Slight retouching of C_{12} and C_{15} is all that should be necessary if the antenna is resonant to the center of the band.

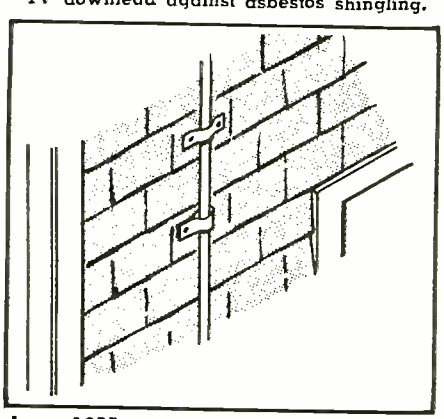
The second method of tuning the output of the amplifier is shown in Fig. 2. This method is similar to the sweep generator method except that the signal generator or v.f.o. is manually swept over the band and the results noted on the meter. The meter readings *versus* frequency is plotted mentally or on graph paper if desired. In this way the effect of a tap change, etc. can be observed. This point-by-point method, while slower, is just as good as the sweep generator method. Make the adjustments with a 300-ohm load resistor as before. When a flat response is obtained substitute the antenna and touch up the tuning of C_{12} and C_{15} as may be required. The meter and detector can be removed. The tuning procedure is now complete and the amplifier ready for use. —30—

PLASTIC DOWNLEAD FASTENERS

By HYMAN HERMAN

IN TV INSTALLATIONS where the lead-in line is to run down along asbestos or wood shingling. I use small strips of plastic, about two inches long, to fasten the wire to the side of the building. These plastic strips are made from ordinary twinlead with the copper conductors removed. The strip is placed across the twin-lead, holding it against the side of the building, and either copper or aluminum nails are used to tack the strip down. These nails prevent streaks. By using small hard steel cut nails, these plastic strips may be used on brick or concrete. —30—

Plastic strips made from twinlead hold TV downlead against asbestos shingling.



Sales Aids

WALSCO SALES FILM

A new motion picture produced for *Walsco Electronics Corporation,* 3225 Exposition Place, Los Angeles 18, California, is now being released for showing to a nation-wide audience of the jobber and dealer salesmen who handle the company's line of TV antennas.

Photographed in color, this fifteen minute film, entitled "Something to Talk About", is specifically designed to supply complete selling information on the firm's antenna production and testing techniques.

Present plans include showings of the movie at special sales meetings held at a local level. For information on the availability of the film for local showings, write the company direct.

E-V PROMOTION MATERIAL

Dramatic and colorful metal merchandisers designed to stock, display, and sell phonograph cartridges in the company's new sealed-in-plastic "Blister-Paks" have been introduced by *Electro-Voice, Inc.* of Buchanan, Michigan.

The new compact, three-color, two-drawer SA-3 merchandiser for the service dealer can be placed on a counter or shelf, or hung anywhere for attention-getting display.

For quick and easy product identification, the front of each drawer represents the "Blister-Pak" package. The new package permits easier servicing because of the full model identifica-

tion, interchangeability chart, and instructions printed on each package.

MANUAL DISPLAY RACK

Supreme Publications, 1760 Balsam Road, Highland Park, Illinois, is currently distributing a newly-designed display stand to all of its active jobbers.

The new stand will aid in calling attention to the firm's line of radio and te… ing… plan… increa… tions.

…ion manuals in addition to holding stock. The company is … steps to aid jobbers in … for its publica-…

CHANNEL MASTER ITEMS

Channel M…, …New York, has … and promotion pr… theme that "1955 i… Banner Year".

To spark the promo… tize the "Banner Year" t… ly-designed satin banners … made available for display b… The banners feature gold lett… deep blue satin with gold tassels, … ing cord, and cross-bar. They are … able for wall or window display.

The package program applies to the

company's entire line of TV accessories. The purpose is to provide all accessories with uniform and distinctive cartons, in step with the latest trends in modern packaging.

Almost identical layout designs are employed on all cartons, uniformly printed with maroon lettering over a blue grid. Though of different shapes and sizes, they are easily identifiable as the company's containers.

WINDOW DISPLAY CONTEST

Retail dealers and distributor salesmen of *RCA Victor* portable radios will be eligible to share $10,000 in prizes which will be awarded in a nation-wide window display contest.

Dealers in each of the company's eight regions will be eligible for prizes totaling $1000 while distributor salesmen servicing them can win up to $250 in each region. The awards will be made for the best windows built around the theme, "Take A Song Along —with an *RCA Victor* Portable". The contest will be in two categories with identical awards for "Most Original Window Display" and "Best Window Using *RCA Victor* Display Material".

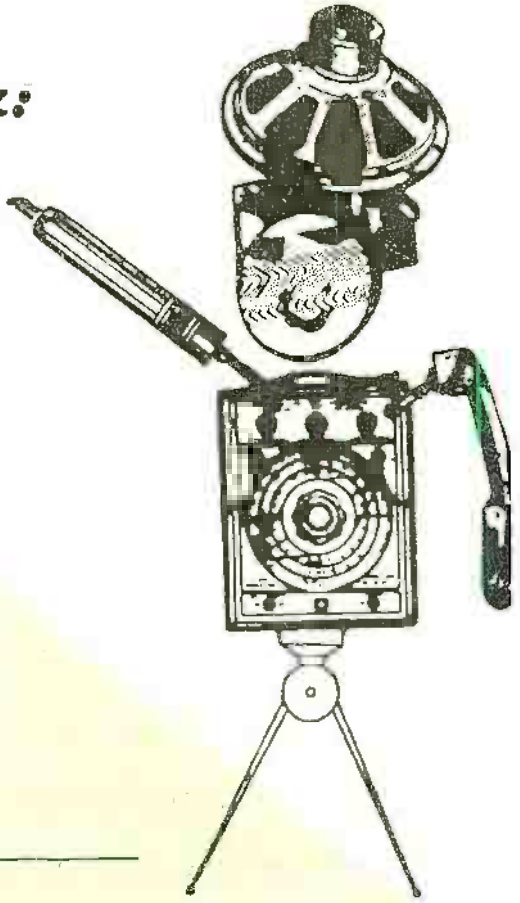
The contest is on now and closes July 9th. To be eligible, a display must remain in a dealer's window for a minimum period of two weeks. For full information on this contest, contact local *RCA* distributors.

CBS-COLUMBIA PROMOTION

CBS-Columbia has planned an elaborate and extensive promotion program to merchandise its new "Advanced 1600" television receiver.

Enter A Subscription For:

RADIO & TELEVISION NEWS



NAME _____

POSITION _____

COMPANY _____

ADDRESS _____

CITY _____ ZONE _____

S-6-55

STATE _____

☐ **Remittance enclosed**

☐ **I'll pay when Billed**

Extra postage per year: Pan America, 50¢: all other foreign countries, (except Canada), $1.00.

☐ **3 years** $9.00

☐ **2 years** $7.00

☐ **1 year** $4.00

FIRST CLASS
Permit No. 37110
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BUSINESS REPLY CARD

No Postage Necessary if Mailed in U. S. A.

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RADIO & TELEVISION NEWS

366 MADISON AVENUE
NEW YORK 17, NEW YORK

An all-out advertising-merchandising program has been set up and will include TV programming support, point-of-purchase material advertising support, etc. The point-of-purchase material includes brightly colored store window streamers, set-top signs, "blue tag" cards, postcard mats for local mailings, reprints of trade and consumer ads, complete salesman's instruction sheets, reply cards, etc.

The whole program is tied in with Arthur Godfrey's programs as well as three other company-sponsored programs. This "Blue Tag Special" promotion is currently being introduced throughout the country *via* closed-circuit telecasts to dealers. —30—

RETMA'S HAM COURSE

IN ORDER to stimulate still further interest in amateur radio, RETMA has prepared and is distributing a complete amateur radio course that has been custom-designed for the beginner. It is based on material prepared by educators, experienced hams, and engineers.

The course consists of code records, theory and license manuals which will be made available from RETMA headquarters, 777 14th Street, N. W., Washington 5, D. C., for $10.00 complete.

A copy of the booklet "Gateway to a Career," describing the ham hobby, is available free. —30—

CERTIFICATES OF MERIT

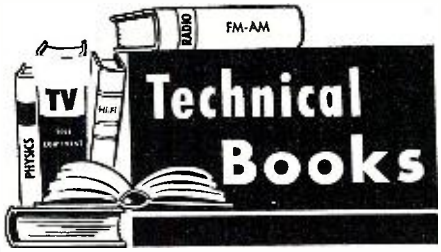
OVER 1200 licensed radio amateurs have been awarded certificates of merit for emergency service during the 1954 hurricanes by the judges of the annual Edison Radio Amateur Award.

The judges cited amateur operators in 28 of the 48 states, mostly in the eastern coastal regions, but also a few in Nevada, Michigan, California, Wisconsin, and Washington as well as the District of Columbia. Operators in Alaska and Puerto Rico were also cited as were many in Canada, especially the Province of Ontario. The certificates have been mailed out by General Electric Company's tube department, sponsors of the Edison Radio Amateur Award.

In granting the hurricane citations, the judges commended the amateurs for one of their most outstanding public services of continuing communications in areas where the "Three Sisters" caused untold destruction. They also pointed out that an unparalleled number of amateur radio operators joined in setting up emergency radio networks which were used for fire, police, and civil defense protection during hurricanes "Carol," "Edna," and "Hazel." The judges based their action on field reports compiled by the American Radio Relay League.

Commendation also was extended to "Many radio amateurs who spent long hours standing by to help if needed—but whose hurricane vigils unfortunately are unrecorded."

These special certificates of merit were in addition to the regular annual awards which are made to amateurs who have rendered exceptional public service to their communities and the nation as a whole through the medium of amateur radio communications. —30—



"TV REPAIR QUESTIONS AND ANSWERS—FRONT ENDS" by Sidney Platt. Published by *John F. Rider Publisher, Inc.,* New York. 120 pages. Price $2.10, paper bound.

Although this is a service manual "with a difference", the material presented is every bit as usable as that provided in the average text.

Presented in question-and-answer form is much valuable information for the practicing TV technician and the student of television work. Techniques and procedures are given precedence over theory in the belief that hard-hitting facts are what most service technicians are seeking.

This particular volume covers the servicing aspects of antennas, transmission lines, and front ends. In order to locate the answers to specific problems which arise, the book is divided into chapters which are based on the signal flow path in the receiver installation.

Although specific servicing problems are taken up in the text, the information supplied in the "answer" portions can be used as a guide to trouble-shooting and repairing the receivers of many manufacturers.

The section on front ends is divided into three chapters dealing with mechanical, electrical, and alignment techniques. Antennas, transmission lines, and boosters and u.h.f. converters each rate a separate chapter.

The technique of providing a "discussion" in addition to the "answer" for each of the problems definitely adds to the value of this manual as it applies the "why's" for those interested in delving a little deeper into the problem.

* * *

"SERVOMECHANISMS AND REGULATING SYSTEM DESIGN" by Harold Chestnut & Robert W. Mayer. Published by *John Wiley & Sons, Inc.,* New York. 375 pages. Price $8.50.

In this, Volume 2, the authors have presented the practical application behind the "theory" presented in their first volume.

Unlike the first volume, which was designed especially for the student and the engineer encountering servomechanisms for the first time, this book is for the practicing designer and the advanced graduate student. Because of this shift in audience, the subject matter has been treated differently and in a more rigorous fashion. The first chapter on measurements is both introductory and in the nature of a review of the material of Volume 1. The other chapters deal with such subjects as the influence of input characteristics on control system design; the selection of controlled system power element with proper rating; networks for obtaining desired attenuation-frequency characteristics; all-a.c. servomechanism operation; amplifier design; linearization of non-linear elements for small departures and large departures; and the application of non-linear elements to control systems.

Unless the student has a fair working knowledge of servomechanisms and a confident ability with things mathematical, it is recommended that the first volume of this series be obtained first and mastered thoroughly.

* * *

"RADAR POCKET BOOK" by R.S.H. Boulding. Published by *D. Van Nostrand Co., Inc.,* New York. 173 pages. Price $3.50.

This compact, concise handbook provides information on the basic electrical principles and formulas applicable to radar. Although the material is considerably compressed, the author has managed to provide an amazing amount of pertinent data in a relatively few pages.

All essential details have been covered including the most modern developments such as the use of crystal rectifiers and transistors. The text material is profusely illustrated by means of typical circuit diagrams of the different units comprising modern radar equipment.

As a concise textbook or a ready-reference for on-the-spot handling of maintenance, this book would be hard to beat. An electrical background is pre-requisite.

* * *

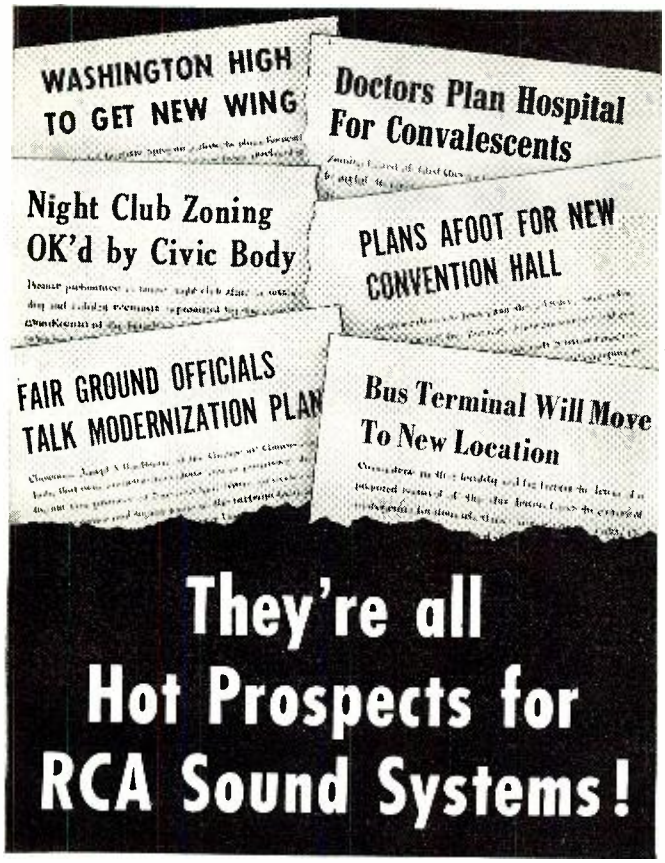
"BASIC VACUUM TUBES AND THEIR USES" by John F. Rider & Henry Jacobowitz. Published by *John F. Rider Publisher, Inc.,* New York. 203 pages. Price $4.50, cloth bound, and $3.00, paper bound.

Why nobody ever thought of writing a really elementary handbook on vacuum tubes before is hard to understand for certainly such a text was overdue. There are literally thousands of laymen and beginning "electronics men" who are interested in the subject but not qualified to handle the subject at an engineering level. This book is for them.

In keeping with the level of the presentation, the authors' style is informal and easy-to-grasp. Complicated mathematics have been dispensed with in favor of "word formulas".

The book itself is divided into five chapters which include a general introduction to the subject and the historical background, electrons and electron emission, diodes, triodes, and multi-electrode tubes. Photographs, line drawings, and clever cartoon-type explanatory material all contribute.

If you have a tyro "electronic technician" in your home, know an intelligent layman who wants authentic but readable information on a subject which influences his life, or have been looking for a thoroughly enjoyable explanation of vacuum tube operation for yourself, this is your book! —30—



With the exception of residences, there are few building projects these days where sound amplification hasn't an important place. It's profitable business, too, if you recommend and install equipment that's *right the first time!*

Rely on your RCA Distributor

Whatever the size or purpose of the installation, your RCA Distributor has the experience, the inventory to help you expedite the kind of job that will lead to others . . . see him first.

CUSTOM-BUILT EQUIPMENT

- Consoles
- Desks
- Turrets
- Cabinets

INTERCOMS

- All Master Systems
- Combination Systems
- Master-Remote Systems

SPEAKERS

- Cone Type
- Wall Type
- High Fidelity
- Console Cabinets

MICROPHONES

- All types
- Stands, plugs, cables and connectors.

RCA

SOUND PRODUCTS

RADIO CORPORATION of AMERICA

ENGINEERING PRODUCTS DIVISION · CAMDEN, N.J.

In Canada: RCA Victor Company Limited, Montreal

Within the Industry

(Continued from page 26)

Washington, D. C. . . . **ESSEX WIRE CORPORATION** has acquired all of the physical assets of **J. M. WHITE, INC.** of Philadelphia, pioneer electrical wire assembly manufacturer. The new subsidiary will be operated as a division of the parent firm . . . The acquisition of **THE LUTHER MFG. CO.** of Olean, N. Y. by **AEROVOX CORPORATION** of New Bedford, Mass. has been announced. The new acquisition will permit the parent company to enlarge its facilities for developing and building automatic production equipment for its various plants . . . **REON RESISTOR CORP.** of Yonkers, N. Y. has purchased the total assets of **COLUMBIA RESISTORS, INC.** of Pearl River, N. Y. All operations have been transferred to the Yonkers plant.

* * *

ROY H. OLSON has been appointed director of engineering in the Communications and Electronics Division of *Motorola, Inc.* In this capacity he will direct the technical activity of the division's industrial products department.

He has been associated with the company since 1951 when he joined the firm's *Phoenix Research Laboratory* as an engineering section leader. He received his degree in electrical engineering from Iowa State in 1934 and immediately thereafter began a 13-year association with *Collins Radio Company.* He subsequently operated his own manufacturing and consulting firm before joining *Motorola.*

* * *

A. R. ANDREWS has been appointed to the post of vice-president and general sales manager of the *Pyramid Electric Company,* North Bergen, New Jersey manufacturer of capacitors and selenium rectifiers. He has been a sales representative for the firm since its founding.

Mr. Andrews formerly headed his own representative firm in Syracuse, N. Y., and is a former treasurer of the Empire State chapter of "The Representatives."

He is a graduate of Bucknell and makes his home in Tenafly, N. J.

* * *

EMERSON RADIO AND PHONOGRAPH CORPORATION has moved its administrative headquarters and plant from the Port Authority Building, 111 Eighth Ave., New York City to Jersey City, New Jersey. The firm's public relations and export departments will remain in New York City, occupying a suite in the Plaza Hotel, Fifth Ave. at 59th . . . **AMPLITEL, INCORPORATED,**

manufacturers of master amplified TV antenna systems, etc., has moved to new and enlarged quarters at 342 West 40th Street in New York . . . **AMPEX CORPORATION** has moved its southeast district office to the Howell House, 710 Peachtree Street, N.E. in Atlanta, Georgia . . . **NATIONAL RADIO DISTRIBUTORS** has moved its main Bronx store to larger quarters at 1165 Southern Boulevard. The new location provides nearly 10,000 square feet of space on a single floor.

* * *

ALFRED Y. BENTLEY has been appointed assistant manager of the Cathode-Ray Tube Division of *Allen B. Du Mont Laboratories, Inc.* He has been with the firm for ten years in various technical and administrative positions . . . The board of directors of *Glass-Solder Engineering* has named **HUGH P. MOORE** president and general manager. He was formerly president of the *Acme Electronics* division of *Aerovox* . . . **ROBERT V. HOLTON** is the new general manager of the electrical products division of *Minnesota Mining & Manufacturing Co.* He has been with the company since 1943. The company also named **DR. WILFRED W. WETZEL** to the post of general manager of its magnetic products division. He joined the firm in 1944 . . . **A. ELLIS JONES** has been named manager of mobile and railroad sales for the *Bendix Communications Division* . . . **JACK S. BELDON** has been named manager of marketing for *General Electric's* radio and television department in Syracuse. He has had extensive experience in the merchandising field . . . *Spencer-Kennedy Laboratories, Inc.* has appointed **WILLIAM K. HEADLEY** to the post of sales manager . . . **EARL OLSON** has been named vice-president in charge of operations at *Jensen Industries, Inc.* He has served as chief engineer of the phono needle firm since 1950 . . . **WILLIAM R. CROTTY** has been promoted to the post of manager of radio and TV sales for *Erie Resistor Corporation's* Electronic Division. He joined the firm in 1939 . . . **WILLIAM O. HAMLIN** has been named supervisor of technical information for *CBS-Hytron.* He was formerly technical editor of *"Sylvania News"* . . . **JOSEPH H. GILLIES** has been appointed vice-president in charge of manufacturing for *Philco Corporation* in addition to his present duties as vice-president and general manager of the firm's Government and industrial division . . . **ROBERT RAYNOR** has been named sales promotion manager to head the new merchandising department of *Clear Beam Antenna Corporation* and *Tempo TV.* He has been with *Clear Beam* for the past three years and will retain his present position as sales manager of the firm . . . **JOHN C. LEGLER** is the new director of advertising and public relations for *Electronics Corporation of America* . . . **MAJOR GENERAL JAMES D. O'CONNELL** has been confirmed as Chief Signal Officer of the Army replacing **MAJOR GENERAL GEORGE I. BACK** who is retiring from the Army. The new Chief Signal

Officer has served as Deputy since December, 1951 . . . **WENDELL TIETSWORTH** has joined *Sonotone Corporation* as assistant sales administrator of the tube division. He was associated with *General Electric* for 20 years prior to accepting his new post . . . **ALEXANDER M. PONIATOFF** has been elected founder and chairman of the board of directors of *Ampex Corporation.* **G. I. LONG** has been named to succeed him in the presidency . . . **WALTER F. MARCH** has been named vice-president in charge of sales for *Lab-Tronics, Inc.* of Chicago. He was formerly associated with *Allied Radio Corp.* in Chicago . . . **VICE ADMIRAL JOHN B. MOSS** (U.S. Navy, Ret.) has been elected to the post of president of *Hoffman Laboratories, Inc.,* a wholly-owned subsidiary of *Hoffman Electronics* . . . **HANNIBAL CHOATE FORD,** founder of the *Ford Instrument Company,* died recently at his estate at Kings Point, Long Island. He was 77 years old . . . **ROBERT L. JABLONSKI** has been appointed national service manager of *Hoffman Radio Div.* He will make his headquarters in Los Angeles . . . **EDWARD R. WAGENHALS** has joined the *Clevite-Brush Development Company* as vice-president and director of components development . . . **HOMER O. SAMS,** sales research director of *Howard W. Sams & Co., Inc.,* passed away recently after a short illness. He was 61 years old and had been associated with the firm for the past eight years.

* * *

RETMA reports that the radio-TV set production figures for February have increased both over those of January and over February of last year. During the month 702,514 TV sets were produced while 1,089,724 radio receivers rolled off the production lines—a healthy increase over the 769,232 last February and 1,068,146 produced in January of this year. —30—

"Souped-Up Viking I"

(*Continued from page 68*)

listening to words and syllables that have a *depth of amplitude.* That is what creates, in part, what we call intelligence of speech. If we take the same words and syllables and try to create a falsetto by making their amplitudes all equal or near so, then we no longer have good intelligence. It becomes a new "noise" or anything else you care to call it. Intelligence is often lost because of the "unnaturalness." Definitely, we hear a louder signal (noise) but is the readability any better? You may sound louder but not necessarily clearer.

So to all you "hot-rodders" may your transmitters take on a new zest for life. You now have a "new" transmitter and this should keep you happy for a few months until someone else finds a better way or has another thought. May your "Vikings" purr along as well as mine does for many years to come. —30—

Mac's Radio Service Shop

(*Continued from page 72*)

and other such defects without ever stepping off the ground."

"Speaking of stacking," Barney offered with a faraway look in his eyes, "How's about my borrowing those binoculars to take with me to Ideal Beach some Sunday? Some of the babes you see over there are really stacked, and—"

"Never mind!" Mac hastily interrupted. "You can get into enough trouble with just your bulging baby blue eyes."

"There's still that biggest package," Barney reminded.

Mac opened the end of the cardboard carton that folded out to form a carrying handle and lifted out a small round picture tube.

"Is that a scope tube?" Barney wanted to know. "It's shaped more like a picture tube, but surely we haven't got any sets in the store with that small a screen."

"This tube," Mac said with a quizzical grin, "is designed to replace magnetically-deflected picture tubes up to twenty-four inches or so."

"Oh yeah; then it must be made of rubber," was Barney's dubious comment.

"No, it's *Sylvania's* new 5AXP4 Television Receiver Check Tube that was described in the February, 1955, *'Sylvania News.'* It *is* intended to replace almost any picture tube you are likely to find in a modern black-and-white TV receiver—but only for testing purposes, of course. It will take anode voltages up to 18,000 volts, requires no ion trap, and is self-focusing. You know I've long wished we could use the fast, reliable, conclusive tube-substitution method of checking the picture tube that is so useful in checking the other tubes in a TV set. Now, thanks to this little job, we can."

"How do you use the tube?"

"Just slip the receiver's yoke over the neck of the tube, put the picture tube socket on its base, and connect up the high-voltage lead. The manufacturer suggests using one of those centering-magnet assemblies with the magnets removed to hold the tube in position in the yoke. This assembly clamps the neck of the tube between flat springs so that it will stay in position."

"That will be pretty handy," Barney said with mounting enthusiasm. "It means we can leave the picture tube right in the cabinet in most cases when we are sure there is nothing wrong with the tube itself and bring only the chassis and deflection yoke to the store. That will be a real help. I never did relish the idea of lugging those big tubes around. There's too much danger of breaking them. On top of that, they're heavy and hard to get out."

"Don't overlook the sales appeal of

this little service tool," Mac said as he used his pocket steel tape to prove the tube face was only five inches in diameter and the over-all length was but ten and a half inches. "When we can show our customer that his set can put out a bright sharp picture on this tube while the picture he gets on his own is weak and faded, if he gets any picture at all, his sales resistance will evaporate. This little persuader will present a much more graphic and convincing argument in favor of ordering a new tube than will a mere meter reading on a tube tester.

"I think this test tube will be especially appreciated by small shops such as we are," Mac went on. "We can't carry a large inventory of picture tubes; so usually we do not have a good tube to try in one of those hard-to-be-sure cases where you feel reasonably confident the picture tube is at fault but you want to be dead-certain before telling the customer a new tube will cure his trouble. This 5AXP4 will take care of those cases for us."

"Changing the subject for a moment," Barney said, "didn't I see Jim taking his recorder out with him? What was wrong? That about had you stumped yesterday."

Mac smiled broadly as he replied: "Yes, that was Jim, and the mystery is solved. What puzzled me, you'll remember, is how the recorder could possibly do what he reported it was doing: namely, suddenly go berserk during playback and erase recorded material while it was playing it and leave only a wavering audio note in its place. He said a recording might sound fine the first two or three times he played it, but the next time he wanted to listen, only this note could be heard —and that was all I could hear when I put one of his tapes on our recorder, too.

"Jim's hobby is recording circus bands—he used to be with a circus, you know—and several of his prized and irreplaceable recordings were ruined by this strange fault of his recorder. What made the thing worse was that I could not make it happen here in the shop. I made a test recording and played it over and over without anything unusual occurring. Finally, while lying in bed last night, I got an idea of what might be happening; and the first thing this morning I tried it out. Sure enough, I could make the same thing happen to the test recording that had been happening to Jim's calliope music."

"What was wrong?" Barney demanded impatiently.

"You'll remember his recorder has two control knobs. One has Play-Off-Record positions; the other reads Wind-Off-Rewind. A red button must be pushed down before the first knob can be turned to Record, and it is held depressed as long as this knob stays in the record position but snaps back up when the knob is turned to Off. Neither knob can be turned from the Off position unless the other knob is

already in that position. However, the red button can be held down manually while the Rewind-Wind knob is worked.

"That's what I did. I simply held this red button down while I was rewinding the tape. This activated the record and erase heads and wiped the recording from the tape. At the same time the signal from the bias oscillator was put on the tape. Remember that the tape was travelling at about ten times its ordinary speed. As you know, slowing down the speed of the tape below the speed at which it was moving when a recording was being made has the effect of lowering the pitch of the recorded material. In this case, when the tape was played at normal speed, the supersonic erase signal that was recorded during fast rewind was brought down into the audible range and provided that mysterious wavering note we heard."

"What was Jim doing wrong?"

"Since he only used the recorder once or twice a year, he forgot how to operate it from one time to the next. He remembered, though, that the red button had to be depressed under some circumstances; so he just depressed it every time he moved any of the knobs. During rewind he held the button down so that he would not hear the normal monkey-chatter you get when the tape is moving fast and the speaker is not cut out or the volume turned down. Sometimes he pushed it far enough to engage the recording switch; other times he did not. I simply had him show me how he operated the recorder before I told him what I had found out; and sure enough, that is what he was doing. I've got him all squared away now, and he says he will see I get a couple of passes the next time the circus hits town. If a certain obstreperous redhead that I know doesn't consider such entertainment beneath his dignity, I'd be glad to include him in this bucolic whingding upon request."

"It's a date!" Barney exclaimed. "I'll buy the peanuts."

—30—

"TAPE OF THE MONTH"

A RECORDED TAPE of the Month Club has been organized recently for the purpose of supplying, on a monthly basis, selections of classical music, pops, satire, comedy, operatic, and folk music on 1200-foot, 7-inch reels of magnetic tape.

A special feature of the Club is the monthly "Preview" tape which is included as one of the services offered for the six-month membership charge of $2.00. The "Preview" tape contains highlights of the forthcoming month's selection and is recorded on a 4-inch reel.

Each member agrees to order at least two regular monthly selections at the special member's price during the six month period. For every three selections ordered by a member, the selection of a free bonus tape is offered.

The Club will supply full details on the plan. Write Recorded Tape of the Month Club, Inc., P. O. Box 195, Radio City Station, New York, New York. —30—

Distortion/Power Adapter

(*Continued from page 55*)

The use of black decals to mark the switch positions and the jacks, and grey *National* HR knobs, help to give the adapter an attractive, "professional" appearance.

The procedure for using the distortion/power adapter is simple and straight-forward. To explain its use, assume that the first amplifier to be checked is one that is rated at ten watts and that the 16-ohm output tap is selected. For the first test the balance control, R_6, should be set at maximum resistance.

The 16-ohm terminals of the amplifier are connected to a plug which fits into the "Amp" jack of the adapter and the a.c. v.t.v.m. is connected to the "Meter" jack. It is best to use shielded wire for these connections. The test oscillator, set to 400 cycles, is connected to the input of the amplifier. The load selector switch, S_1, is set to "16", and S_2, the meter switch, to "Pwr."

As the table indicates that for ten watts the voltage across a 16-ohm load resistor is 12.6 volts, with the gain control of the amplifier full on, the output of the oscillator is adjusted for a meter reading of 12.6 volts.

Next, the meter switch is turned to "Set" and the meter-set control, R_5, adjusted for a meter reading of 10 volts. (Had the voltage across the load, as determined from the table, been less than ten volts, then a meter reading of one volt would have been used for the meter-set adjustment.) Set the meter switch to "Read." Now carefully vary the frequency of the test oscillator for the lowest possible meter reading. By adjusting the balance control this reading should be further reduced. The correct setting of the ballance control and the oscillator frequency dial is where the minimum voltmeter reading is obtained.

No further adjustment of the balance control should be necessary.

Assume the minimum is .5 volt. As 10 volts (due to the adjustment of the meter-set control) represented ten watts, or 100% output, then .5 volt equals 5% of the output. This 5% is the harmonic distortion of the amplifier at ten watts output.

As this 5% measurement includes the test oscillator harmonics and the noise voltages of the amplifier, it is obvious that in order for the harmonic measurement to be accurate, the oscillator should be reasonably free from harmonics and the amplifier noise level should be low. Do not attempt to test an amplifier for distortion until excessive hum, tube, and circuit noise are eliminated.

Four hundred cycles was chosen as the test frequency as the second and third harmonics (800 and 1200 cycles) lie within the most sensitive frequency range of the ear, making these harmonics the most annoying. With the choke and capacitors specified, the

usual commercial tolerances may result in a test frequency somewhat different from 400 cycles. In practice, this is of little importance.

Now that the amplifier has been tested, the next step is to make the usual resistance and voltage measurements and adjustments in the circuit to determine if the distortion can be reduced. Since the effect of each change made in the amplifier circuit can be easily checked, trouble-shooting even small amounts of distortion becomes a simple step-by-step process.

Although this adapter will not take the place of a good-quality intermodulation or harmonic distortion meter, its small size and ease of operation make it well worth-while where more elaborate instruments cannot be justified due to their size and cost. —30—

INTERNATIONAL YLRL MEET

THE Los Angeles Young Ladies Radio Club, with Mildred Griffin, W6PJU, president and official hostess, will sponsor the first international YLRL convention June 24, 25, and 26 at the Miramar Hotel in Santa Monica, California.

The affair promises to be an interesting one, both from the standpoint of the program that has been planned and because of the fact that licensed women radio operators from Africa, Hawaii, Canada, and all U.S. districts will attend. The League membership now numbers more than 600 women in the U.S., Alaska, Hawaii, Canal Zone, Canada, England, France, Italy, Africa, Belgium, Netherlands, Australia, and New Zealand.

Vada Letcher, W6CEE, is national YLRL president this year and will preside at this unique conclave.

The program includes a reception and registration on Friday (June 24); luncheon, business meeting, and program Saturday noon with a YL/OM banquet Saturday night; a beach picnic at Santa Monica Bay on Sunday; and a tour of Hollywood tourist spots on Monday morning.

The registration fee is $10.00 for the gals with the husbands being included in the banquet activities upon payment of a $5.00 fee. Contact Gloria Matuska, W9YBC, the publicity chairman of the event, for further information. —30—

Vada Letcher, W6CEE, national president of the Young Ladies Radio League, boards the plane to fly to San Francisco to extend a personal invitation to the S.F. unit to attend the International Convention which will be held June 24, 25, 26 in Santa Monica.

Manufacturers' Literature

PHILCO PARTS CATALOGUE

A new type of parts and accessories catalogue is currently being offered all *Philco* dealers and technicians by the Accessory Division of *Philco Corporation*, of Philadelphia.

The catalogue contains part and accessory descriptions, ordering and price information, technical data, and display material arranged in an attractive format.

Current information on all products, including over 24,000 of the company's service and universal replacement parts, as well as other makes of electronic and appliance products, has been catalogued by part number for convenience in ordering.

Philco distributors are handling this catalogue.

GERMANIUM DIODE DATA

The Semi-Conductor Division, *International Rectifier Corporation,* 1521 East Grand Ave., El Segundo, Calif., has published a new bulletin, GD-2, which lists the ratings and specifications on the company's line of germanium diodes.

It describes the firm's complete line of point-contact diodes and offers specifications on high-temperature, computer, u.h.f. mixer, meter protection, and general purpose units. A complete interchangeability and replacement chart is also included.

This bulletin is available only on letterhead request direct to the manufacturer.

REPLACEMENT FLYBACKS

Triad Transformer Corporation, 4055 Redwood Ave., Venice, Calif., has available copies of its television replacement guide, TV-55.

Included in the listing are six new correct replacement flyback transformers which have been designed to be interchangeable with original equipment found in *Zenith, Muntz, Crosley, Sentinel, Hallicrafters, Admiral,* and *RCA* receivers.

Model numbers and chassis for which the new transformers are suitable are listed in the guide, which is available on request.

MICROWAVE SYSTEM

The Engineering Products Division, Dept. P-420, *Radio Corporation of America,* Camden, N. J., has issued a comprehensive "guidebook" to the nature and applications of the first microwave system designed for use in the unused frequency band of the microwave spectrum, 2450-2700 mc.

The booklet describes the recently-announced MM-26 microwave system

which makes available 250 mc. of uncrowded channel space, provides up to 30 voice channels, and permits establishment of new microwave stations in geographic areas already closed or crowded.

The publication also illustrates how up to nine parallel duplex systems can be used in this frequency range in a given locality to meet requirements of utilities, pipeline operations, railroads, turnpikes, and commercial carriers.

SOUND EQUIPMENT

Altec Lansing Corporation, 9356 Santa Monica Blvd., Beverly Hills, Calif., or 161 Sixth Ave., New York 13, N. Y., has just issued a complete engineering catalogue especially for professional sound equipment users.

The new publication contains complete technical data on all of the company's sound products. It covers AM-FM tuners; transcription reproduction arms; twelve different broadcast, p.a., and scientific microphones; more than twenty amplifiers and preamps, power supplies, control consoles; and nineteen different speakers, horns, cabinets, and matching transformers.

Distribution of this catalogue is limited to professional users and is available from the company direct or from the firm's sound contractors.

ELECTRONIC TIMERS

A 5-page brochure with current information describing the standard line of electronic timers manufactured by *G. C. Wilson & Co.*, 1950 8th Ave., Huntington, W. Va., is now available on request.

Included in the line are delay, repeat cycle, and interval timers, all of which are available as stock items.

CUSTOM TV DATA

A new booklet which suggests ways to custom-install television receivers has been published by *Conrac, Inc.*, of Glendora, Calif.

Entitled "A Fleeting Glance at Fleetwood Custom Television", the booklet presents ideas for installations in every room of the house. Photos of installations feature both remotely- and conventionally-controlled receivers. Among such examples is a TV set in the bedroom wall with a tuning unit in the bed headboard.

AUTO REPLACEMENTS

A new automobile radio replacement guide, #3, is now available from *Merit Coil and Transformer Corp.*, 4427 North Clark Street, Chicago, Ill.

The new catalogue lists replacements for all model cars up to and including 1955 and also features the company's line of vibrator transformers, speaker outputs, and i.f. and r.f. transformers.

TV TUBE CHART

CBS-Hytron of Danvers, Mass., has announced the availability of a Second Edition of its "Substitution Chart for TV Picture Tubes."

This newly-revised chart provides all

the necessary substitution information for all electromagnetically deflected types, irrespective of make, including the "Mirror-Back" (aluminized) types. In easy-to-find, easy-to-read fashion, it indicates directly interchangeable types as well as substitutes requiring a minimum of service changes.

A handy index lists all picture tube types and places each in its correct substitution group. Then by a tabulation of characteristics within each group, the best choice of an individual substitute type is made easy to find.

Service dealers may obtain a copy from their *CBS-Hytron* distributors without charge.

ELECTRICAL TAPES

A new four-page brochure entitled "*Permacel* 2 in 1 Electrical Tapes" is now available from the *Permacel Tape Corporation* of New Brunswick, N. J.

The publication discusses the advantages of using the company's tapes and supplies a complete table of technical data, illustrating the curing cycle, tensile strength, and seven other pertinent factors relating to the backing of these tapes which are composed of various materials ranging from glass cloth to crepe paper.

A copy of this brochure is available from the Advertising Services Department of the company.

ELECTRONIC PROJECTS

Henry Francis Parks, 104 S. E. 57th Ave., Portland 15, Ore., is offering copies of Catalogue No. 3 which lists some 44 projects which are currently available to the electronically-minded experimenter.

There are twenty-one categories covering timers, intercoms, relays, counters, broadcast-radio, power supplies, wired-radio broadcasting equipment, musical instruments, receivers, amplifiers, model controls, remote controls, transceivers, etc., to mention a few in the electronic field.

The company offers the requisite circuit diagrams to build this various apparatus and, in the case of special parts, offers the components as well.

The catalogue is available without charge upon written request.

STANCOR FLYBACKS

Chicago Standard Transformer Corporation, Addison and Elston, Chicago 18, Ill., has released a comprehensive data sheet describing and illustrating the six new *Stancor* exact replacement flyback transformers which have been designed for *General Electric* receivers.

Detailed information on the models using these units is given in this publication, which has been designated as the *Stancor* Bulletin 504. It is available from distributors or from the company direct.

"BRANDED FOR LIFE"

C & H Supply Company, 415 E. Beach Ave., Inglewood, Calif., is now distributing copies of its colorful brochure, "Branded for Life".

The book explains in detail how its "Metal-Cals", an anodized, etched

aluminum nameplate, can be used for quick, economical trademarking, serial numbering, service labeling, etc. In addition to telling what the units are and how they may be ordered, the new booklet contains a montage layout of typical units, representing industries and products from every part of the country.

CAPACITOR DATA

Gudeman Company, 340 W. Huron St., Chicago 10, Ill., now has available a new 6-page, 2-color bulletin illustrating and giving complete technical information on its miniature flat "Mylar" dielectric capacitors.

Bulletin No. 337-8 includes tables of capacitance values and voltage ratings, dimensional drawings, an explanation of catalogue numbers, data on voltage derating for high temperature operation, dielectric material, and seals, capacitance change, lead specifications, test voltage, life test, power factor, insulation resistance, moisture resistance test, etc.

Copies of this publication are available without charge on request.

TV TRANSMISSION LINE

Prodelin Inc., of Kearny, N. J., is now offering copies of its Catalogue No. 415 entitled "Transmission Line for VHF and UHF Television".

The catalogue lists briefly the types of line available, and then presents transmission line efficiency graphs on the various lines. The material is listed in the most concise form possible for maximum utility.

ASA STANDARDS LISTING

The American Standards Association, 70 East 45th St., New York 17, N. Y., has published a 48-page index which lists some 1500 currently available standards.

There are 210 standards for construction and civil engineering, 153 mechanical, 272 electrical, 158 safety, 165 textile and wearing apparel, 251 photography and motion pictures, 74 petroleum products, 69 chemical, 62 metallurgy, 38 gas-burning appliances, 32 drawings, 10 office equipment and supplies, and a miscellany of others.

This list is available without charge from the Association.

VIBRATOR REPLACEMENTS

Vokar Corporation of Dexter, Mich., has just issued a comprehensive cross reference and replacement guide, No. 108.

The publication is divided into three sections covering the radio or car make and model with the *Vokar* vibrator part number, the original equipment part numbers with the company's cross reference, and a cross index of *Vokar* and other vibrator manufacturers' part numbers.

The material is presented in tabular form for quick reference.

PICTURE TUBE GUIDE

General Electric Company's Tube Department, 1 River Road, Schenectady 5, N. Y., has announced the avail-

ability of a new edition of its "Quick Selection Guide for Television Picture Tubes", publication (ETD-1001A).

The purpose of this new booklet is to help designers select a particular tube from the large number of types now on the market. It lists 205 tube types and for each of these the following information is listed: whether it is aluminized or not, external conductive coating capacitance, type of ion-trap magnet, face, dimensions, and style of anode terminal.

DAVOHM RESISTOR

The *Daven Electronic Sales Corp.*, 191 Central Ave., Newark 4, N. J., is currently offering a new six-page brochure describing in detail its recently-announced *"Davohm"* Series 850 resistor.

The new unit is a metal film type which combines predictable accuracy with low cost and production availability. The brochure gives full performance details on the ½-, 1-, and 2-watt sizes. It is available only on letterhead request.

CATALOGUE SUPPLEMENT

Newark Electric Company, 223 W. Madison St., Chicago 6, Ill., has issued copies of its Supplement No. 60 covering the latest releases for industry, radio, TV, and high-fidelity applications.

This compact 48-page booklet illustrates and describes a wide variety of equipment and component parts. The material is completely indexed for ready reference.

Copies are available without charge upon written request to the company.

TELEX DATA

Telex, Inc., Telex Park, St. Paul 1, Minn., is now offering two new catalogue sheets describing the advantages and applications of its miniature jack and plug combination and its new dynamic earphone.

The jack and plug combination, one-third the size of previous models, is designed to be used in computers, dictating machines, tape recorders, and miniature radios. The literature illustrates and describes these applications and provides complete specifications. The two-color catalogue sheet on the earphone shows how the unit is worn and lists its uses from stenography to aviation.

Either or both of the data sheets are available on request from Dept. KP of the company at 1633 Eustis St.

INTERCHANGEABILITY GUIDE

A new "quick answer" disc-type phonograph cartridge interchangeability guide is now being offered free to technicians and service dealers by *Electro-Voice, Inc.*, of Buchanan, Mich.

A turn of the wheel shows at a glance the correct *E-V* model to replace any popular crystal or ceramic phono cartridge. Effective use of contrasting colors makes the up-to-date information easy to read. A specification table shows the tracking force, frequency response, voltage output, ap-

plication rpm, needle number, and list price of the *E-V* cartridges.

The guide is only 6½" in diameter and is easy to carry on service calls either in the service coat pocket or in the tool and tube caddy.

TRANSISTOR BOOKLET

A new booklet, written especially for hams, has just been published by the Electronics Division of *Hydro-Aire, Inc.*

Entitled "The Transistor and You," the booklet will be distributed without charge through electronic jobbers that carry the firm's CQ-1 low-cost junction units designed for amateur applications.

The booklet contains instructions and circuit diagrams for a three-stage transistorized regenerative radio receiver, low-cost broadcast receiver, dynamic microphone preamp, radiophone monitor, electronic timer, relay control circuit, electronic time generator, audio oscillator, and field strength meter.

In addition to jobbers, the book is available from the company at 3000 Winona Ave., Burbank, Calif. —30—

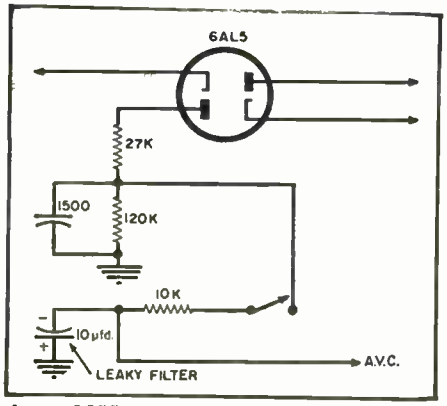
When to Pull a Chassis

(*Continued from page 51*)

There was a certain 10 μfd. filter capacitor to ground in the a.v.c. leg. This filter sometimes develops a high leakage. In any other application there would be no difficulty. But in this spot, it harms the sensitive a.v.c. voltage. (See Fig. 3.) This, in turn, does not allow the video amplifier input to hold at a "must" level of six volts peak-to-peak. That was the repair. The filter was replaced with one of less leakage, and the picture cleaned right up.

The whole idea of our TV service business is to fix TV sets satisfactorily, make the set owners happy, and enjoy a profit for our efforts. If a defective part is easily located and replaced, these TV service requirements can be met right in the home. However, if you run into hornet's nest wiring or perplexing troubleshooting, the only sure way to do your job is to pull the chassis into the shop. —30—

Fig. 3. An overloaded picture resulted from the leaky a.v.c. filter capacitor shown here. This was fixed in the shop.



DENVER DX CONTEST WINNERS

Hams receive their awards at gala banquet sponsored by RAPSCO in Denver, Colo.

RADIO Products Sales Company was host at a gala banquet held recently in Denver to honor the winners of its first annual DX contest.

Hams within a radius of 250 miles of Denver were eligible to compete with judging based on QSL cards earned during the months of September, October, and November of last year.

The top award went to Ed Wier, WØOEV of Denver who contacted over 67 countries and earned 208 confirmations during the contest period. W. A. Wessel of Denver was second; R. V. Rosellini was third; T. D. Littlejohn was fourth, while Earl Cochran of Colorado Springs was fifth.

The first prize was "winner's choice" of a top ham receiver while the other prizes included ham gear donated by *Harvey-Wells, Gonset, Thordarson-Meissner, Sonar, Wen,* and *Bliley. RAPSCO* donated the award for the top prize.

The company plans to sponsor the contest annually to stimulate interest in amateur radio. —30—

Ed Wier, WØOEV, of Denver was named winner with 208 confirmed contacts in 67 countries. He selected a Hallicrafters SX88 as prize.

Glenn Brocker of RAPSCO presents second-place winner, Pete Wessel, WØJYW, his Gonset "Bantam Beam" during the award dinner.

R. V. Rosellini, WØSYA, beams his pleasure over his Harvey-Wells "Bandmaster V.F.O." third prize in the Denver DX-ing contest.

Claude Maer, Rocky Mountain ARRL director; Walter E. Nettles, owner of Denver's Radio Products Sales Co.; Bill Clyne, FCC engineer-in-charge, Denver; and first-prize winner, Ed Wier, at the award dinner held at Denver's Park Lane Hotel.

techniques. It has gained much from this and now, in addition to being the best performance, is quite satisfying sonically. String tone is cleaner, less edgy, the brasses have more bite and percussion is better defined. "Iberia" is a newer recording but is still no youngster. This recording gained some notoriety as Toscanini was not satisfied with it and refused to OK it for quite a period. Evidently his objections have been overcome and the flaw rectified. Not the best sound in the world, it has generally clean strings, rather thick textured brass and woodwinds, fair percussion. The performance is good—a rather subdued one for a Toscanini. His tempi are slower than most and in his striving for contrast the work loses a little of its spontaneity.

A fine disc for the beginning hi-fi fan or for those who want the ultimate in performance of "La Mer". Curve was OK, as were surfaces.

HANDEL

THE WATER MUSIC (COMPLETE) Boyd Neel Orchestra conducted by Boyd Neel. London LL1128. RIAA curve. Price $3.98.

Hard on the heels of the excellent version by Hewitt on the *Haydn Society* label comes this complete version of the "Water Music" by that old master of Handel, Boyd Neel. The Hewitt was a good recording and an excellent performance and it is a shame it must be superseded so quickly. However, there is no denying the authority of Boyd Neel. His performance is as deft and knowledgable here as his justly celebrated readings of Handel's "Concerto Grossi". His tempi, his handling of orchestral textures, and above all the classic grace with which he imbues the work, make this the preferred version. The orchestra is also better than the Hewitt group. String tone is better, as is the phrasing. The horn players are much superior with big solid tones. Last, but not least, this is smoother, richer, more wide-range sound, with better balance and superior acoustics. Sounds like a triumph, right down the line, doesn't it? Well, it is, but if you have acquired the *Haydn Society* disc you need not feel too badly. That is still an estimable recording.

If you are going to add this work to your library, this disc will probably stand the test of time better than any other version. No curve adjustment was needed. Moderately quiet surfaces.

STRAVINSKY

L'HISTORIE DU SOLDAT
OCTET FOR WIND INSTRUMENTS
SYMPHONY OF WIND INSTRUMENTS

NorthWest German Radio Orchestra conducted by Igor Stravinsky. Columbia 5ML4964. NARTB (old) curve. Price $5.95.

Now that "L'Histoire" has been recorded almost half a dozen times, the master himself takes a crack at the score. Like many Stravinsky-conducted performances of his own works, this isn't what it might seem to be. One can hardly question the authority of interpretation, yet for some reason other people seem to do a better job! Or at least the score sounds more "listenable" in the hands of other conductors. I can't pinpoint for you why this should be so, except in isolated instances. The tempi which Stravinsky employs in this work seem too fast as compared to other readings. The work seems to lose cohesion and gives the impres-

sion of being disjointed. However, this is only my opinion and you may like the work in its authentic garb.

Paradoxically, the "Octet for Wind Instruments" is infinitely better sounding here than in any previous version. Here Stravinsky's sense of rhythm gives the score new zest and life. The "Symphony" is a rarity and gets its premiere performance on LP. Made some time ago with Stravinsky conducting the Northwest German Radio Orchestra, it employs a very large wind section (26 men) and is an amazing study in wind sonorities.

Soundwise the disc is variable. The "L'Histoire" is given a good clean recording with fine string tone which does not lack bite in the proper sections and with bright brass and rich sounding clarinet. The percussion lacks strength and generally the work is not as good sounding as the recent *Vanguard* effort. The "Octet" fares better and is quite clean and articulate. The "Symphony" was made in 1951 in Germany —a fact which is not difficult to discern. A few db bass boost helped the NARTB curve. Good surfaces.

SAINT SAENS
PIANO CONCERTO #2
PIANO CONCERTO #5
Pro Musica Symphony, Vienna, conducted by Hans Swarowsky with Orazio Frugoni, pianist. Vox PL8410. NARTB (old) curve. Price $5.95.

A good bargain record here with two of Saint Saens most interesting piano concerti as the attractions. Frugoni is an excellent technician and the difficulties of the scores are taken with ease. His tone is slightly hard and if this artist could get a little more warmth into his interpretations, he would be a talent to contend with. Soundwise the disc is about the best available of these works. Generally good piano tone, on the glassy side at times, good brass and string tone in the orchestral accompaniment. If you like rich sounding big-boned concerti in the grand romantic manner you will enjoy these. No curve adjustment was necessary and surfaces were quiet.

KODALY
PSALMUS HUGARICUS
London Philharmonic Choir and Orchestra conducted by Georg Solti.
THE PEACOCK (VARIATIONS)
London Philharmonic Orchestra conducted by Georg Solti. London LL1020. RIAA curve. Price $3.98.

This is the second version of the "Psalmus Hungaricus" on LP and is superior in every aspect to the *Urania* recording. If you are not familiar with this work and you like choral music, I urge you to listen—this is a very thrilling large scale work. Kodaly has a particular facility for writing highly dramatic, very "listenable" modern choral works as anyone who has heard his "Te Deum" or "Missa Brevis in Tempore Belli" can testify. The score is heard in English on this disc and while this makes for intelligence, it plays havoc with some of the choral textures.

Conductor Solti, who is making quite a name for himself in the *London* catalogue, is in his element here. He knows the idiom and he makes the most of it. His tempi are metronomically perfect, his balance is sensible and his dynamic phrasing is expressive without being overblown. I give you fair warning, the score is fairly quiet in the opening measures, but soon the work asserts itself with a gigantic outpouring of choral sound. The dynamic range is quite astounding. Soundwise this features superb choral articulation, clean strings, nice crisp brass and woodwinds and an excellent choral/orchestral balance is maintained.

The "Peacock Variations" has been recorded previously by Antal Dorati and the Minneapolis Symphony and I find I prefer that reading to this effort. Solti's reading is highly competent—a nicely paced, well integrated job. However, he does not have the insight into the score that Dorati has and he tends to oversentimentalize. Good smooth sound here, but not on a par with the sharply focussed robust sound on the Dorati disc. All in all, this is a disc worth your attention. Curve was OK and surfaces were quiet.

RIEGGER
SYMPHONY #3
Eastman Rochester Symphony Orchestra conducted by Howard Hanson.
MENNIN
SYMPHONY #3
New York Philharmonic conducted by Dimitri Mitropoulos. Columbia 4ML4902. NARTB (old) curve. Price $4.98.

If you are a lover of modern music you will find this disc particularly rewarding. Two of America's better composers give us their third symphonies, and furnish some interesting contrasts. Riegger's work is unabashedly atonal and is, I think, one of the best examples of this type of writing to come from our country. Richly scored, the best passages occur in the tremendous passacaglia and fugue with which the symphony concludes. Mennin's work is more conventional, but is nonetheless interesting. His use of strings is sure-handed and logical and is a far cry from the tactics of most of his contemporaries. Like most modern works, these lend themselves very well to hi-fi sound and *Columbia* has done one of its best jobs in capturing the excitement of brass and percussion. Both are quite wide range and have good dynamics. Acoustics could have been improved—a little on the dry side and somewhat cramped. The NARTB curve did not need adjustment.

RACHMANINOFF
PIANO CONCERTO #2
St. Louis Symphony Orchestra conducted by Vladimir Golschmann with Leonard Pennario, pianist. Capitol P8302. RIAA curve. Price $4.98.

This is the 13th version of this work on LP and one of the best. Young Leonard Pennario does his usual competent job here, but indulges in a few mannerisms and some tempo-tampering that keeps it out of the definitive bracket. However, I will say this, not since the old Rubenstein reading has anyone captured the essentially lyric and romantic qualities of the work as well as Mr. Pennario. Soundwise this is about the most hi-fi available. The piano is clean and sharply defined, if a little hard-toned at times. The strings are quite smooth, the brass is particularly sonorous and woodwind sound is very "live". The poor acoustics which have marred other recordings of the St. Louis group are not in evidence here. A nicely balanced sound prevails throughout. A good recording for fledgling hi-fanatics or those who want to modernize their libraries. Curve did not need adjustment. Very quiet surfaces.

SIBELIUS
SYMPHONY #2
NBC Symphony Orchestra conducted by Leopold Stokowski. Victor LM1854. RIAA curve. Price $3.98.

Sibelius recordings will be coming thick and fast throughout this year as tribute is paid him on the occasion of his 90th birthday. This is the 10th version of his most popular symphony to appear, and as far as I am concerned, they can stop right here. Boy, this has everything. Stokowski's performance is many times at variance with

the score, but he makes of the work a vivid, exciting, warmly human experience. There will be howls from the purists, but I think the work benefits by Mr. Stokowski's accentuated dynamics and rich expression.

The sound is one of the finest things to come from *Victor* in some time. The strings are virtually edgeless, the brass is brilliant and weighty, the percussion super-articulate and of great impact. The trumpets in the finale are really something to hear in their triumphant outpouring. Some remarkable sound textures in the contrabassi. Dynamic and frequency range are very wide and distortion is practically nonexistent, even in the inner grooves. Unreservedly recommended to you.

LISZT
HUNGARIAN RHAPSODY #2
MASSENET
PRELUDE AND LA NUIT DE NOEL (FROM "WERTHER")
L'Orchestra de la Societe des Concerts du Conservatoire de Paris conducted by Albert Wolff. London LD9171. RIAA curve. Price $2.98.

The Massenet pieces on this disc we can dismiss with the comment that they are well played and recorded. The prize here is an absolutely incredible performance of the "Hungarian Rhapsody". I never thought I would enjoy hearing this ancient creaking warhorse again, but the performance of Wolff and the wonderful sound has changed all that! Everything about this is big—the reading is vast, expansive, a hugely proportioned sonic edifice conducted at a much slower pace than might be thought judicious. Wolff gets away with it by maintaining a miraculous balance which keeps the work from becoming turgid. The sound is definitely "big hall"—that elusive quality that gives massive weight to the lower strings and brass. A very homogeneous sound, but still one that does not suffer from loss of detail. Percussion is notable for its sharply focused impact. Dynamic range is exceptional, as is the frequency response. If you have a good system, especially one that can handle the bass, then this will be a great record for impressing friends. No curve adjustment was necessary.

BRITTEN
SINFONIA DA REQUIEM
DIVERSIONS ON A THEME FOR PIANO AND ORCHESTRA
London Symphony Orchestra and Danish State Radio Orchestra conducted by Benjamin Britten with Julius Katchen pianist. London LL1123. RIAA curve. Price $3.98.

In spite of the Italianate name, the "Sinfonia da Requiem" was actually composed as a tribute to the 2600th anniversary of the Emperor's dynasty in Japan! Let me hasten to add, however, that the music is not programmatic in content, so don't expect to hear the sound of the samisen! The work has an interesting history. The content was actually approved by the Japanese government, but was rejected on religious grounds as insulting to the Emperor. Be that as it may, this is an interesting work, and is, as the title implies, a somber dark-hued piece. Britten's extraordinary faculty for orchestration shows up to advantage in the brilliant scherzo and the tremendous emotion of the finale.

The "Diversions for Piano" are typical of the more light-hearted, witty type of thing that we have come to associate with this composer. Katchen is his usual brilliant self in this work, and he handles the many complex passages with easy grace. This work is a bonanza for the hi-fi fan, as there are many percussives used as well as the piano being used in a percussive sense. The

"Requiem" has some good tympani sound in the opening passages along with excellent string tone and some stirring brass sound. If your musical appetites are somewhat jaded, this disc might be just the thing. Try it!

ANTHEIL
BALLET MECHANIQUE
BRANT
SIGNS AND ALARMS
GALAXY 2000
Columbia 4ML4956. NARTB (old) curve. Price $4.98.

Well, boys, they don't come much wilder than this! Positively the dawgondest collection of noise ever recorded. Why, compared to this, Varese's "Ionization" is almost baroque. The "Ballet Mechanique" was *the avant garde* work of the early twenties and caused as much of a riot as "Le Sacre" at its premiere performance. It is not hard to realize that the work was probably written with tongue in cheek, for hearing it now impresses one only with its posturing. There will probably be many who like this for its hi-fi content. I freely admit that in addition to liking music I have a predilection for exciting hi-fi sound. But I am not so "wild-eyed" that I can enjoy listening to noise at the expense of music. No matter how open-mindedly I approach this score, I can't see it. As for sound, you have snare drums, tympani, bass drum, tam-tam, cymbals, etc., etc., etc., even the employment of the sound of an airplane propeller. As far as it goes, 'tis good recording. Transients are generally clean and dynamics are quite wide. The works on the flip side are sonic trifles that sound like background music for B-grade space movies. But don't let me frighten you away—could be you might like this sort of thing. It's your ears and your nerves—so go ahead! Give this platter a whirl!

WALTON
PORTSMOUTH POINT OVERTURE
SIESTA
SCAPINO
WISE VIRGINS BALLET (BACH)
London Philharmonic Orchestra conducted by Sir Adrian Boult. London LL1165. RIAA curve. Price $3.98.

This is a perfectly wonderful disc. The music is interesting, the sound is among the best *London* has ever recorded, and the playing of the orchestra and conducting is of a very high order. You can practically smell the sea and see the sailormen dancing the hornpipe in the "Portsmouth Point." The score is not consciously programmatic, but Walton has nonetheless drawn us a pretty vivid and graphic picture of a bustling waterfront. The music is very gay and spritely and should appeal to most hi-fi fans.

The other works are interesting, each in its own way, and the "Wise Virgins" here receives the best sound and best performance on records. Once again this is "big hall" sound, and one of the most successful of this breed extant. The brass is formidable in its clarity and weight, the high strings clean and sweet and the celli and contrabassi ultra-sonorous. Superb woodwind intonation in the "Wise Virgins." Great, robust percussion, especially the bass drum in the "Portsmouth Point." Sir Adrian keeps all his forces on their toes and elicits some fabulous playing from his men, especially the brass players. Very low distortion throughout the disc and dynamics which are startling. It is not hard to predict that this disc will become a highly regarded demonsration record. Curve was better with a slight bass boost and surfaces of my copy were quiet.

No tape reviews this month, but a new batch is due to arrive soon and this feature will then be resumed.

—30—

RADIO-TV Service Industry News

AS REPORTED BY THE TELEVISION TECHNICIANS LECTURE BUREAU

FOR those who are taking the time to review developments in all activities at the consumer level, one thing stands out crystal clear—we are in the midst of a shifting, changing retail economy that will have a marked influence on the future of all businesses that serve the public directly. This, of course, will include the business of servicing television, radios, and other electronic equipment in the home.

When you start a business, you immediately become a part of a vast economic machine that can either propel you into the situation known as a "successful business operation," or it can grind you into nothingness as just another figure in the statistics of business failures. There are some elements in the operation of your business that you control; there are other elements that are completely outside of your control. Your success or failure will be determined by your ability to properly handle the elements that are under your control and your sagacity in guiding your business with the changing economic pattern. The one requires a good knowledge of the best management practices in your type of business, and the other requires frequent objective, realistic appraisals of the changing business scene.

Fair Trading

Harry B. Price, Jr., dynamic president of NARDA (National Appliance and Radio Dealers Association), passed along some sound advice to radio-appliance dealers in a recent talk in San Francisco. "The war is on," he said. "At the manufacturers' level it is to be competitive or die. At the distributors' level, it's justify your existence or close up. And at the dealer level we must recognize the change and adjust to it.

"I do not think there is any substitute for integrity in any business," he continued. "You must operate at an established retail price. All customers, regardless of race, creed, color, or privilege, should pay the same price in your store. The doing away with list prices isn't shocking. Retailers who have been selling below list did away with list prices a long time ago. We must all understand this—neither you, your distributor, nor your manufacturer establishes the ultimate selling price of our products. The public determines the price it will pay. Decide how you will adapt yourself to a changing market. There never will be a substitute for integrity, value, or service, but if someone develops a more economical way to deliver all three—watch out! It is a human shortcoming to resist change. However, failure to recognize sound progress can relegate one to failure."

Dealers who have been deeply concerned about the growing competition from discount houses will now have to face up to the realities of a changing pattern of distribution. The recommendation by the U. S. Attorney General's committee that all fair trade legislation should be scrapped may spur the repeal of the laws that have made fair trade price fixing legal.

These developments are of special significance to the service industry because radio-appliance dealers who have been most successful in combatting the discount houses in their areas have constantly stressed the fact that consistently good *service* on the products they sell has been a vital factor in successfully meeting the competition of the "low price-no service" outlets. We are knocking on the door of a new era of tremendous expansion in the electronics industry—the era of color television. It would not be surprising if the engineering ingenuity that has sparked so many phenomenal developments in the electronics industry will find a solution to the cost factor in the production of color TV and so get color television rolling before the end of this year. Most certainly, a great deal of engineering research is at work on this problem of color television cost with an eye on the national political conventions and subsequent presidential campaigns that will be underway within a year. The set manufacturing industry will throw all of its resources into the production and sale of color TV sets to take full advantage of the natural sales opportunity this quadrennial political campaign will provide.

Competent, efficient service will be a prime factor in the sale of color TV sets at all times. Who will handle the bulk of this service will depend on the people who buy the sets.

Buyer preference for service on a product normally is for the dealer from whom the product is purchased. This is natural, of course, for the purchaser has initially shown his confidence in the dealer by buying the merchandise from him. He feels that the dealer's organization will take a special interest in the device since they sold it and that they know best how to keep it in good operating condition because of their close association with the company that made it.

In the event that the retailer does not have a service department, the average buyer's preference for service is either for "factory authorized" or "factory supervised" service. Where direct factory service is available, a high percentage of consumers will select that type of service rather than any other.

This factor of buyer preference will probably force every major producer of color television sets into the service business in most major areas. The service contract will probably come back into the picture again and thousands of people who were hurt in the failure of large independent service companies will refuse to buy contracts unless they are backed by the manufacturer of the set.

Outside the major centers, forward-looking television-appliance retailers will institute their own service departments because of the competitive advantage it will give them over the non-servicing dealers and the multiple-product merchandisers.

Independent Service

In numerous areas there are independent service companies that have handled installations and service for retailers successfully for so many years that they will move into the color television servicing field as a normal expansion of their clients' activities. Numerically, these service companies represent only a very small segment of the independent service industry, so their operations are in no way typical of the independent service companies that are now operating self-developed c.o.d. businesses. It is this latter segment of the servicing industry that will be most affected by a major shift of service to manufacturer-controlled or dealer-controlled television service. Any decided shift of this kind would not only affect color television servicing; it would also bring about a shift in who handles monochrome TV servicing.

Previously, it was pointed out that the controlling factor in who will handle the bulk of color television service will be the general public—the people who buy the sets. One of the trends in mass preference that has been accelerating during the past few years has been that of patronizing big stores and big companies. On Fridays and Saturdays, when long lines of customers line up at check-out counters to pay for their heavily-laden push-carts of groceries and sundries at the supermarkets, community independent grocers struggle to keep their busi-

nesses going. In many cases, the total saving at the supermarket is less than the cost of the transportation to get there, but families flock to them in preference to the nearby, small, independent grocers.

Of course, these immense supermarkets are show-places; they long ago outgrew the grocery, meats, and vegetables aspects of their business and now display and sell products that have been bread-and-butter items in drug and hardware stores and novelty shops. The average American consumer likes drama and excitement and is always on the prowl for something different. The supermarket is giving it to them. Time was when a goodly segment of the American public took a keen delight in looking for small shops where they could buy something different from the run-of-the-mill items handled by the large stores. These small shops with unusual products and services are still in existence—although gradually diminishing in numbers—as the public gradually bows to standardization of the things they wear, eat, and live with.

These are definitely trends in the living and buying habits of the public, and they affect independent servicing and retail businesses equally as much as the independent grocers and druggists. On the face of it, these trends seem to portray a rather gloomy picture for the future of the independent electronic service dealer. They appear to indicate that as an important business entity, independent servicing will follow the path of the independent grocers who have steadily lost ground to better organized and merchandising-minded competition.

However, there is no reason why independent service should permit other industry elements to trample it and take over the work it has done so well. To hold its ground, the first thing the service industry must acknowledge and accept is that the "rugged individualist" no longer has the place he once had in the economic pattern of our country. This is the age of cooperation among men working in a common cause. It is an age when competitors must learn to work together for their common good and pool their resources to provide the force behind their activities that will offset the power and effectiveness of big competition.

The second thing independent service must acknowledge and accept is that it must assume the responsibility for financing its bids for acceptance and power. No other element of the industry is going to hand independent service a wad of dough and say "Here's the money to sell your know-how and facilities to the American public." If that job is accomplished it must be financed primarily by the concerns that make up the legitimate, independent service industry.

The third important factor that independent service must accept is that threats will not deter competition from either dealers, distributors, or set manufacturers. The paramount factor

will be—who can do the job most efficiently at the least cost?

It is a well-known fact that no other type of organization can handle electronic service as efficiently and effectively as a well-managed, competently-staffed, independent service company. Such a company is geared to the business and consumer individualities in the area where it operates. Management is direct and positive. It is able to shift promotional emphasis swiftly from product to product as the occasion demands. It is always a profitable venture for the owner-manager and a dependable place of employment for its regular staff of employees.

There are literally thousands of independent service shops of various sizes whose owners now have the know-how and experience to expand their facilities and organizations to take care of the increased service load that color television will bring. This is a truism about locally owned and managed independent service companies that must be sold to the public on a national scale. The selling job that is necessary is much too big and expensive for a single company or even a strong local or state association to do for itself. It can be accomplished by the combined efforts of the majority of the full-time service businesses in all sections of the country who will benefit from the public acceptance that a well-designed and ingeniously promoted national campaign would bring about.

As an example of what national cooperation can do for independent dealers and retailers, take a look at the strength and dominance of the independent hardware dealers in their field. Their segment of retailing has been least affected by the trend toward mass distribution through chain stores and super retailing outlets.

The independent hardware dealers have been able to hold their position because of the strength, power, and dynamic nature of their national association—The Independent Hardware Dealers Association. This organization is able to match and even excel the promotional power of big combines. One graphic illustration is the two-page ad in color that the IHDA ran in *Life* magazine recently to support the local promotions of its members in every section of the country.

Another example of cooperative action among competitors to increase the efficiency of their individual businesses and reduce some of their operating costs is a plan for centralized warehousing and one-service delivery now being considered by members of the National Retail Dry Goods Association. Under this plan, area merchants would give up their individual bulk warehouses and substitute central warehousing for all area members. They would also abandon their individual delivery operations and handle this function through a centralized delivery agency.

In our own industry, the National Appliance and Radio-TV Dealers Asso-

ciation makes available to its members many types of insurance protection at unusually low rates because of the aggregate amount of the premium payments made by participating members. Because of the facilities made possible by the financial cooperation of many thousands of members located in all sections of the country, NARDA was able to perfect a standard accounting system for appliance and radio-TV dealers specifically designed for their type of business. Also, through the cooperation of their members, they conduct an annual "cost of doing business" survey that provides their members with invaluable information for appraising the efficiency of their businesses in relation to the national averages.

Service Associations

It has been interesting to observe the fast-growing interest among established service operators in all sections of the country in cooperative efforts through associations. Those that are fortunate enough to be headed up by officers who give freely of their time to plan organization programs and carry them out, have shown unusual progress in their activities.

In Indianapolis, Indiana, for instance, the Indianapolis Television Technicians Association has made remarkable progress in making the area a healthier place to do business for full-time, ethically-operated, independent television service businesses. The ITTA works closely with the Better Business Bureau. They are constantly alert to take advantage of every good promotional opportunity to focus public attention on ITTA members and what their double guarantee means in the way of competent service at fair charges. When the "Dragnet" TV program on TV servicing was telecast earlier this year, ITTA tied in with a spot to call set owners' attention to the association and why its members could be relied upon to give honest, reliable, and efficient television service.

One of the current programs of the association is designed to curb the activities of the low-service-charge advertisers who make up the difference by overcharging for the tubes they replace. The ITTA retained an advertising agency to design a striking mailing piece that includes the average *list prices* of the most commonly used receiving type tubes. Thousands of these flyers will be distributed house-to-house and by mail. Set owners are urged to keep the tube price charts and to check the tube charges made by any service technician or company that services the set. Fringe operators who get by on tube overcharges will head into a situation where practically any set owner may check their tube charges against one of these schedules.

Another association that is doing a terrific job on service promotion for their members and building set owner good-will is TISA of St. Louis. They are issuing technician identification and classification cards to qualified

shop owners and technicians in their area and urging set owners to ask to see the qualification card of any technician they call to service a set.

Dozens of other service associations in various parts of the country are using equally good promotions to help set owners identify ethically operated, competent service shops and technicians.

These cooperative programs are accomplishing excellent results in their areas, but they would be much more effective if they were supported by a national program that would enable the set owner to identify the dependable, competent shops regardless of where he may live. —30—

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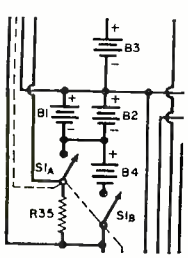
ERRATA

Later production models of the new TV turret tuner, described in the article by Walter Buchsbaum on page 42 of the April 1955 issue, have incorporated some changes. The u.h.f. crystal is no longer mounted on the tuner chassis, under the trapdoor and, therefore, the clips are no longer on the chassis. The crystal is now mounted onto the u.h.f. strip directly. On the "T" series tuners, the crystal is connected to the number 1 terminal and the numbers 9 and 11 terminals are no longer used for this purpose.

We neglected to mention in the article that only the 21 mc. tuners use a 6J6 mixer-oscillator tube. One of the tubes used on the 41 mc. tuner is the 6AT8, which does not require neutralization at 41 mc. besides its other advantages as stated in the article. Standard Coil tuners using the 41 mc. i.f. band employ u.h.f. strips on which single conversion takes place directly from u.h.f. to i.f.

* * *

Two errors in the diagram of the scintillation counter (Fig. 2, page 36 of the April 1955 issue) have been brought to our attention. Capacitor C_1 should be connected in parallel with PL_1; in other words, the righthand terminal of C_1 should be connected to the top end of R_1 rather than the bottom end.



Also, the wiring of switch S_{1A} should be as indicated in the diagram (left) rather than as shown in the original schematic.

INDEX OF Advertisers

JUNE 1955

While every precaution is taken to insure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of this index.

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Rate 50c per word. Minimum 10 words

RADIO ENGINEERING

COMPLETE radio, electronics theory & practice; television; broadcasting; servicing; aviation, marine, police radio. 12 or 18 months. Catalog. Valparaiso Technical Institute, Dept. N, Valparaiso, Ind.

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RADIOSONDES, T49C transmitter with battery box, antenna, less 3A5 tube. $1.35 postpaid. Electronic bargain list for stamp. Palmer, 1440 Las Salinas, Sacramento 21, California. Californians add 3% tax.

COMPLETE VHF Radio Terminals. These are designed for telephone service in the 72-76 mc. band, and are ideal for setting up a communication system along a pipeline, railroad, or in mountainous or bush country. Each terminal consists of the following: 1—Link Radio Type 1498T Transmitter; 1—Link Radio Type 1498P Power Supply; 1—Link Radio Type 1498R Receiver; 1—Budelman 200 watt Power Amplifier; 1—Type PP13 Power Supply; 1—Federal Type 101B V-F Ringer; 500 ft. —Type RG 8U Coaxial Cable; 2—Welded steel Yagi Antennas—5 element; 1—Lister Diesel-Generator set, 2 KW. P. J. Plishner, 550 Fifth Avenue, New York City.

CONDENSERS and Resistors 10 lb. assortment $7.95. Ham Radio Parts Assortment 10 lb. $4.95. 300 M.A. Selenium rectifiers 99¢ each. "Tinys," 1000 W. Pembroke, Hampton, Va.

HI-FIDELITY Bargains: English 7½ and 3¾ IPS Tape Deck. Push button operation, electronic braking, silent drive with 3 four pole shaded motors, fast forward and rewind position breaks oscillator circuit, accidental erasure impossible. Your cost $59.50. Preamp with connecting harness for above, only $39.75. Authorized Distributors of the Finest Hi-Fidelity Lines. Changers, Turntables, Baffles, Amplifiers, Tuners, Speakers, Etc. Write Today Concerning your requirements. All shipments prepaid and insured. Diamond and Sapphire stylus for RPX-050 only $10.50. Heavy Simulated Leather covered base for garrard, Collaro or blank base with hinged covers to protect your changers, only $9.50. Free Audio Consultation Service. Write Today. Fidelity Unlimited, Dept. RN. 63-03 39th Ave., Woodside 77, N. Y.

TUBES and equipment bought, sold, and exchanged. For action and a fair deal write B. N. Gensler, W2LNI, 512 Broadway, New York 12, N. Y.

DIAGRAMS—Radio $1.00; record changers, recorders $1.25. Television with service data $2.00. Where model unknown, give part numbers. Kramer's Radio Service, Dept. S53, 36 Columbus Ave., New York 23, N. Y.

TELEVISIONS, Working. $30 up. W4API, 1420 South Randolph, Arlington 4, Virginia.

TUBES—70% to 90% Discount. Government, manufacturers, jobbers, etc. surplus. Guaranteed 1 year. Free catalog on request. Cadillac Trading, Dept. AD, 231-07 Linden Blvd., Jamaica 11, N. Y.

ALUMINUM Tubing, Angle and Channel, Plain and Perforated Sheet. Willard Radcliff, Fostoria, Ohio.

FREE: Get our monthly electronic lists. Dick Rose, Everett, Wash.

FOR Sale—Geiger Counter Kits $38.50. Geiger Counter & Scintillator Diagrams $1.00. Free Catalog. "R. F. Chambers," 13833 San Antonio Dr., Norwalk, Calif.

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SCINTILLATION Crystals. Sodium Iodide, Thallium activated hermetically sealed tested. 1"x1" $75. 1½"x1" $120, 1¾"x2" $250. Shelby Instrument, 1701 Magnolia, Long Beach, Calif.

DIAGRAMS for repairing radios $1.00. Television $2.00. Give make, model. Diagram Service, Box 672-RN, Hartford 1, Conn.

TV-FM antennas. All types including UHF. Mounts, Accessories. Lowest prices. Wholesale Supply Co., Dept. H, Lunenburg, Mass.

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WHOLESALE High-Fidelity Radios. Phonographs. Towers, 935 North 40th, Philadelphia 4.

RESISTORS, condensers, micas, electrolytics, chokes, etc., thousands of latest pigtail types, new, some leads cut & formed. Eleven pounds for $9.00. Prepaid. Cagan Sales, Box 1152, Rochester, New York.

TAPE Recorders, Tapes, Accessories. Unusual Values. Dressner, Box 66R, Peter Stuyvesant Station, N. Y. 9.

WANTED

AN/APR-4, AN/APR-9, other "APR-," "ARR-," "TS-," ARC-1, ARC-3, ART-13, everything surplus; Tubes, Manuals. Laboratory equipment. Describe, price in first letter. Engineering Associates, 434 Patterson Rd., Dayton 9, Ohio.

WILL Buy All. ART-13/type T-47A $225.00. Art-13/type T-47 $150.00. BC-788C Altimeters Receiver, $150.00. R5/ARN7 Radio Compass $160.00. ARC-3 Complete $185.00. BC-348 Rec'r Modified $35. BC-348 Rec'r unmodified $50. ARC-1 Radio $150.00. BC-312 Rec'r $40.00. BC-342 Rec'r $50.00. Ship Via Express C.O.D., Subject to inspection to: H. Finnegan, 49-57 Washington Ave., Little Ferry, New Jersey.

WANTED—ART-13 transmitters, parts, and components, DY-12 and DY-17 dynamotors, CU-25, etc. Also ARC-1 and ARN-7 material. Advise price condition first letter. Florida Aircraft Radio & Marine, Inc., P.O. Box 205, International Airport Branch, Miami 48, Florida.

30-50, 152-172mc. FM crystal controlled receivers. Box 8136 Kansas City, Missouri.

EDISON, Columbia, and other old cylinder phonographs, parts, horns, and accessories; also, early Victrolas, Pathe, etc. prior to 1915. Trade new hi-fi equipment or will buy for cash if reasonable. Write full particulars to Box 50, % Radio & Television News.

HELP WANTED

TELEVISION Jobs—Names and addresses of companies to contact. $1.00. Fitzgerald, Dept. A-14, 815 Countryside Drive, Wheaton, Illinois.

INSTRUCTORS, well-versed in Radio and Television. Send complete resume of education and experience to Educational Director, Electronics Institute, Inc., 21 Henry Street, Detroit 1, Michigan.

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YOUR FCC first phone license in a hurry. Nation's largest professional school offers brand new, streamlined course. Guaranteed coaching—nationwide placement. Full information rushed to you free (no salesman will call). Get the best—it costs no more! Northwest Radio & Television School, 1221 N.W. 21st Ave., Portland 9, Ore.

B.Sc. in E.E. major Electronics and Postgraduate degrees earned through extension division. American College of Engineering, Box 27724(C), Hollywood 27, California.

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BUY many hot radio items from Japan. General Mercantile, exporters, CPO Box 680, Tokyo.

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PREPARE for high paying job in Radar. Correspondence Course. Write Progressive Electronics Institute, P.O. Box 543, Akron 9, Ohio.

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25-50% DISCOUNT on guaranteed factory fresh LP records, and pre-recorded tape. Send 20¢ for complete LP catalogue. Record Sales, 4710 Caroline, Houston 4, Texas.

PHONOGRAPH Records 20¢. Catalogue. Paramount, N-313 East Market, Wilkes-Barre, Penna.

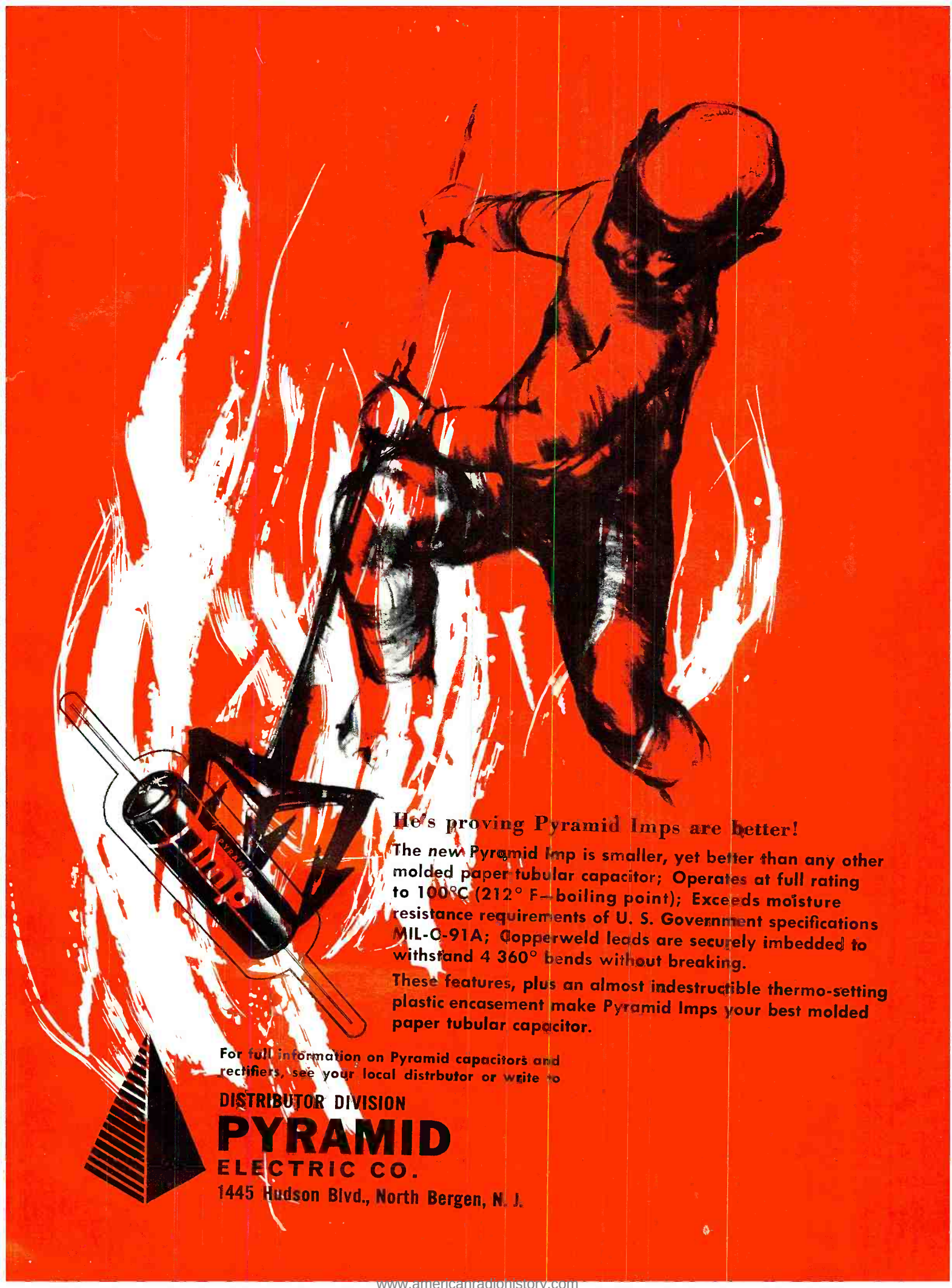
MISCELLANEOUS

HI-FI 16" Transcriptions List 10¢. Transcriptions, 166 Barkley, Clifton, N. J.

ALL makes HI-FI speakers repaired. Amprite Speaker Service, 70 Vesey St., New York City 7.

VITA drive. An effective plasticizer-cleaner for slipping rubber drives, idler wheels and belts used in Record Players, Record Changers and Tape Recorders. You'll be pleased with the results! 75¢ a bottle. Postage extra. Friend's Wholesale Distributors, 106 N. 6th Street, Philadelphia 6, Pa.

DIAMOND needles $9.95, Sapphires 98¢. Guaranteed re-tipping service (free literature). Stylusco, Box 322(R), Mt. Vernon, N. Y.



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